TM 11-5021

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO TEST SET TS-654/GRR-1

DEPARTMENT OF THE ARMY • JULY 1949

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OMAR N. BRADLEY
Chief of Staff, United States Army

OFFICIAL:
EDWARD F. WITSELL
Major General
The Adjutant General

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Figure 1. Radio Test Set TS–654/GRR–1.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

This technical manual contains instructions for the installation, operation, maintenance, and repair, and shipment and storage information of Radio Test Set TS–654/GRR–1 (fig. 1). In addition to these instructions, there are two appendixes covering a list of references and an identification table of parts.

2. Forms and Records

a. Forms. The following forms are used in reporting operations and maintenance of the equipment:

WD AGO Form 468. Unsatisfactory Equipment Report.

AF Form 54, Unsatisfactory Report.

(1) *WD AGO Form 468 (Unsatisfactory Equipment Report) for equipment used by the Army.* WD AGO Form 468 will be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C., when trouble occurs more often than is normal, as determined by qualified repair personnel.

(2) *AF Form 54 (Unsatisfactory Report) for equipment used by the Air Force.* AF Form 54 will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, in accordance with AF Regulation 15–54.

b. Other Forms and Records. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. General. Radio Test Set TS–654/GRR–1 is a portable, self-contained battery-operated unit. The set is used to provide an operational field check of the firing-error indicating system consisting of Radio Transmitting Equipments AN/ART–4 (XA–3) and AN/ART–4 (XA–4), and Radio Receiving Equipment AN/GRR–1. It is not intended for laboratory standardization of either the transmitters or the receivers.

b. Checking Transmitting Equipment. The test set is used as a receiver in checking the operation of the transmitting equipment. The transmitting equipment is checked for the proper operating frequencies and r-f (radio-frequency) signal strength. In addition, the test set checks the transmitter batteries and is used as an indicator for peaking the output of the transmitter.

c. Checking Receiving Equipment. The test set is used as a transmitter in checking the operation of Radio Receivers R–245/GRR–1 and R–246/GRR–1. The receivers are checked for the proper operating frequencies and sensitivity. In addition, the test set checks the operation of the zone counters in Range Computer CP–51/GRR–1.

4. Technical Characteristics

Frequency range:	
High channel	56.75 mc (megacycles) ±0.250 mc.
Low channel	55.50 mc ±0.250 mc.
Transmitter type	Mopa (master oscillator power amplifier).
Type of signal transmitted	Pulse, 10 cps (cycles per second).
Type of modulation	Frequency, −100 kc (kilocycles) deviation from center frequency.
Number of tubes	9.
Power input:	
Two Batteries BA–51 in series	135 volts, 0.024 ampere.
One Battery BA–15–A	1.5 volts, 1.10 amperes.
Antenna	Loop; 5-inch diameter, ⅜-inch cross-section.
Vacuum-tube voltmeter:	
Scale	0–150 microamperes.
Sensitivity	20 microamperes per 0.1 volt rms (root mean square) rf.

5. Table of Components

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu. ft.)	Weight (lb.)
Radio Test Set TS–654/GRR–1	1	9	11. 5	12. 75	0. 76	16. 5
Antenna*	1	⅜	5 (diam)			
Battery test cable*	1			18. 5		
Tripod	1	35 to 59. 5				4. 5
TM 11–5021	2	10. 25		7. 875		

*Packed in cover of carrying case.

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

6. Packaging Data

a. When packaged for shipment, the components of Radio Test Set TS–654/GRR–1 are packed in two wooden cases. A cutaway view of the case containing the test unit is shown in figure 2. The size, weight, and volume of each case are given in the following chart:

Note. Items may be packaged in a manner different from that shown, depending on supply channel.

Number of cases	Height (in.)	Width (in.)	Depth (in.)	Volume (cu. ft.)	Weight (lb.)
1	10. 5	13	16	1. 27	28
1	5. 5	6	36. 5	. 69	11

b. The following list indicates the contents of each case. See the packing list attached to each case for exact contents.

Case dimensions (in.)	Contents	Notes
10.5 x 13 x 16	1—Radio Test Set TS–654/GRR–1 with tubes 2—TM 11–5021.	Loop antenna and battery test cable packed in cover of test case, less batteries.
5.5 x 6 x 36.5	1—Tripod for mounting test set.	

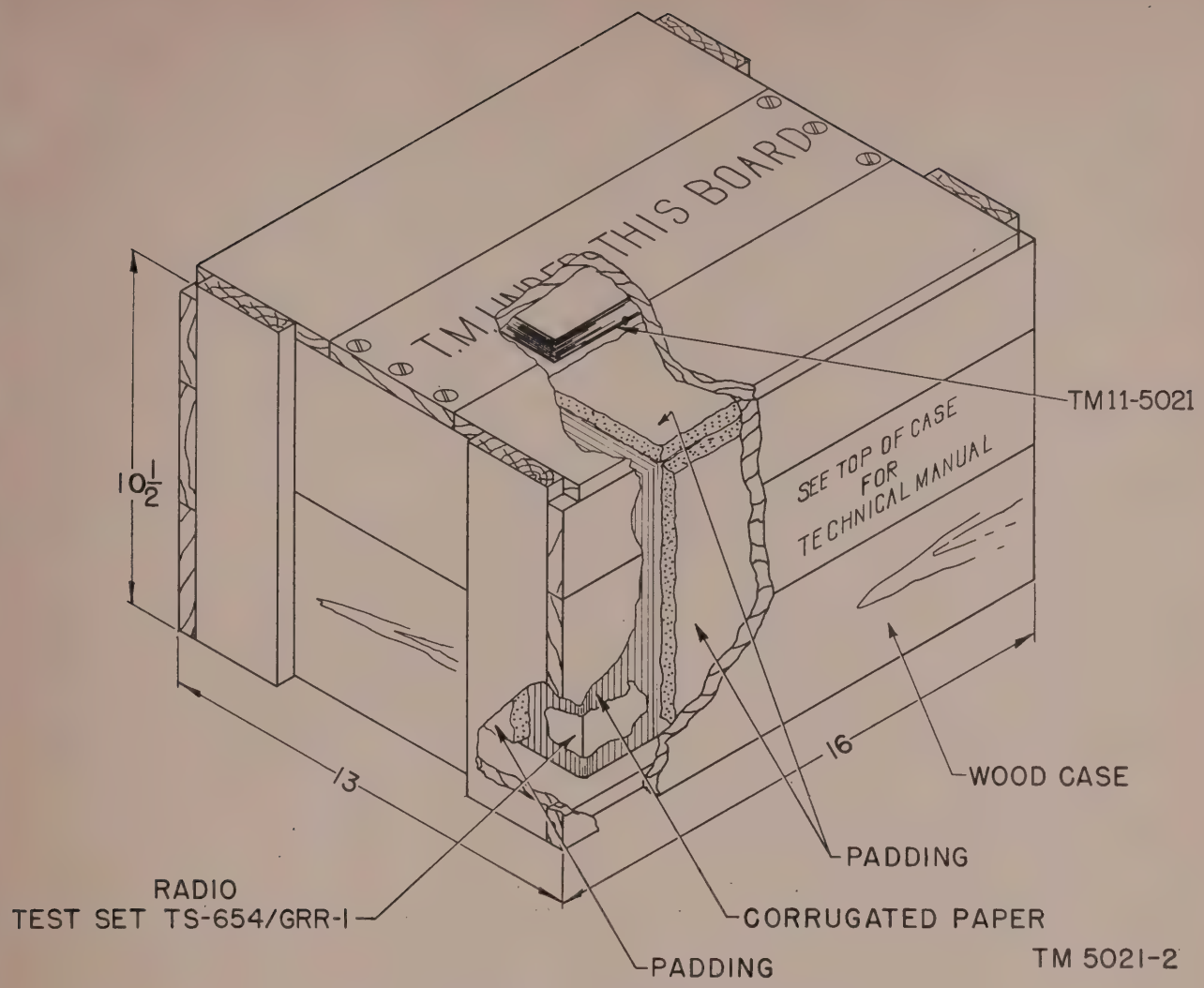


Figure 2. Radio Test Set TS–654/GRR–1, packaging.

7. Additional Equipment Required

The following is not supplied as part of Radio Test Set TS–654/GRR–1 but is required for its operation:

Two Batteries BA–51, 67.5-volt dry cell batteries.

One Battery BA–15–A, 1.5-volt dry cell battery.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. INSTALLATION OF RADIO TEST SET TS–654/GRR–1

8. Siting

Radio Test Set TS–654/GRR–1 is a special type intended for use with Radio Receiving Equipment AN/GRR–1 and Radio Transmitting Equipment AN/ART-4(XA–3), and (XA–4). Therefore, the site of the test set will be determined by the location of the equipment to be calibrated. The test should be performed in a location that has no trees, buildings, or aircraft within 30 yards of the test set and the equipment which is being tested. There should be no signals in the range of 55 mc to 57 mc in the immediate vicinity of the test.

9. Uncrating, Unpacking, and Checking

a. The test set comes packed in a strapped wooden case (fig. 2). Be careful in uncrating, unpacking, and handling the equipment; it is easily damaged. If it becomes damaged, a complete overhaul might be required or the equipment might be rendered useless.

Note. Save the original packing box and padding for possible use in repacking for shipment or storage.

b. The following are step-by-step instructions for uncrating and unpacking:

(1) Cut and fold back the steel straps.
(2) Remove the nails with a nail puller. Remove the top and one side of the packing case. Do not attempt to pry off the sides and top, or the equipment may be damaged.
(3) Remove the padding.
(4) Remove the equipment from the case and place it on a work bench.
(5) Remove the corrugated paper and inspect the equipment for possible damage incurred during shipment.
(6) Check the contents of the packing case against the packing slip.

10. Installation

a. Except for the insertion of the internal batteries, the test set comes completely assembled. Insert the batteries as follows:

(1) Unfasten the six fasteners which hold the front panel to the case.
(2) Carefully lift out the assembly and turn it over, control panel down.
(3) Remove the two thumbscrews which hold the battery bracket in place.
(4) Insert two Batteries BA–51 and one Battery BA–15–A.
(5) Connect the battery terminal wires (fig. 3).
(6) Replace the battery bracket and tighten the two thumbscrews.
(7) Turn the assembly over and replace it in the case; secure the six fasteners.

b. A tripod (fig. 1) is provided for elevating the test set 4.5 to 5 feet above ground. Set the test set on the tripod as follows:

(1) Loosen screws on each of the tripod legs and extend the telescoping sections to the desired length.
(2) Tighten screws after extending tripod legs.
(3) Mount the test set on top of the tripod head and secure it with the bolt which extends below the tripod head and screws into the tripod mounting plate (fig. 22).

c. Open the test set cover and mount the antenna loop on the LOOP terminals of the control panel.

d. Set up the test set and its tripod 20 feet away from the equipment to be tested. The control panel should be level and between 4.5 and 5 feet above the ground (fig. 4).

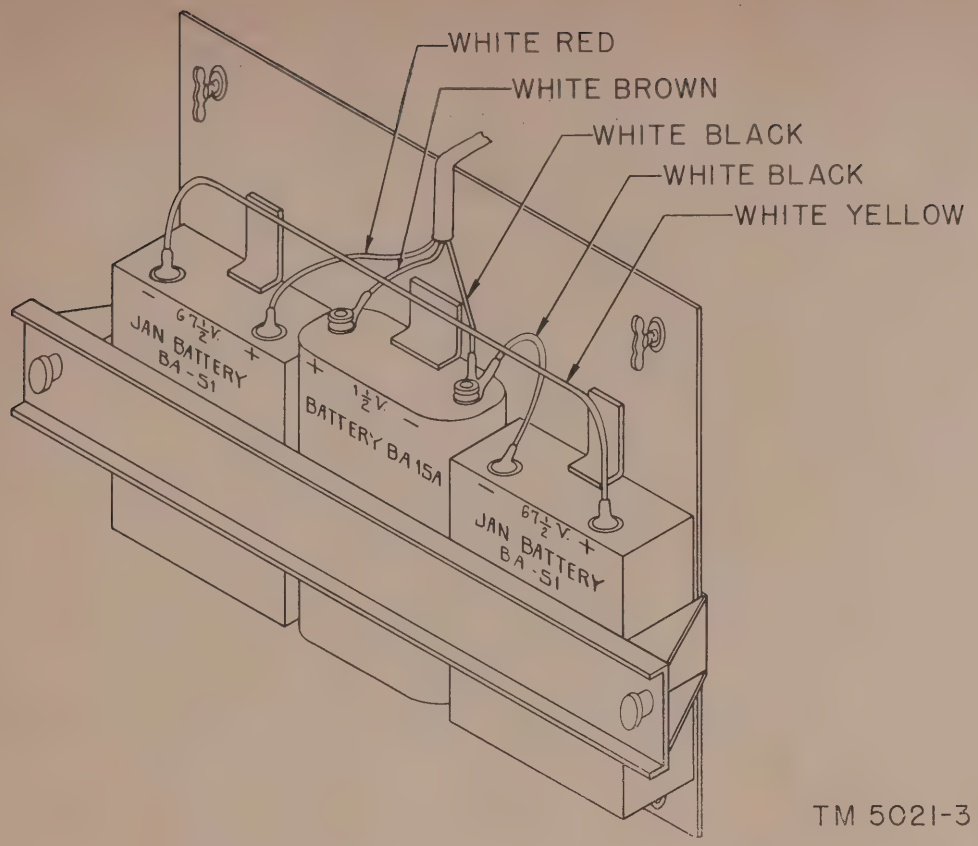


Figure 3. Radio Test Set TS–654/GRR–1, battery connections.

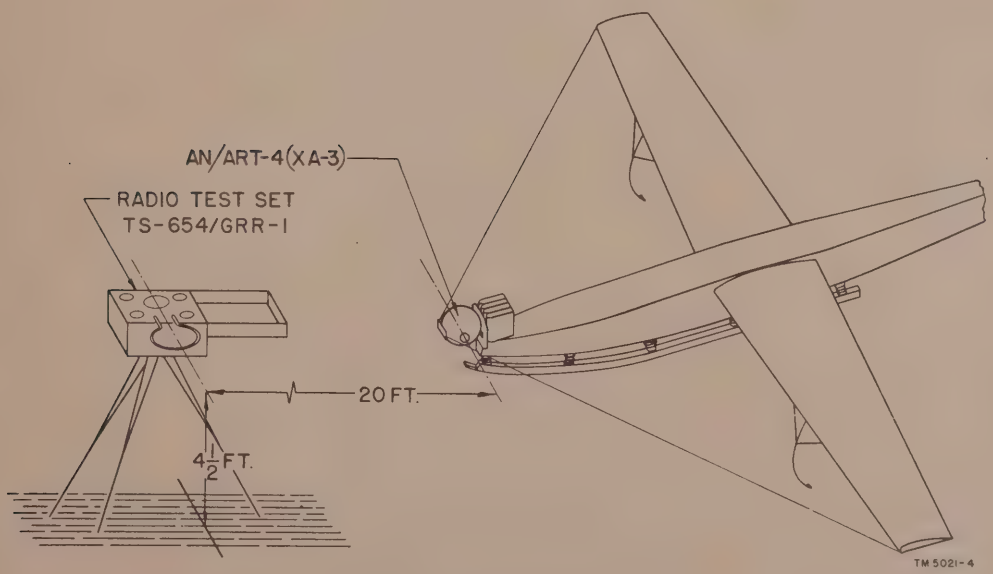


Figure 4. Testing Radio Transmitting Equipment AN/ART–4 (XA–3).

11. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 9 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications of changes in the wiring of the equipment. If any changes in wiring have been made, note the change in this manual, preferably on the schematic diagram.

Section II. CONTROLS AND INSTRUMENTS

12. Controls and Their Use (fig. 5)

The following table lists the controls of the test set and indicates what they do:

Control	Function
RECEIVER—EXTERNAL BATT TEST TARGET (S102)	Three-position switch with a spring return to center position: *Position* — *Function* Center — OFF position and the position at which the internal batteries are tested. RECEIVER — Applies power to the tubes. Test set is used in this position as a transmitter to check Radio Receiving Equipment AN/GRR–1. EXTERNAL BATT TEST TARGET. — Applies power to VTVM circuits. Test set is used in this position as a signal strength meter to check Radio Transmitting Equipment AN/ART–4(XA–3) and (XA–4). In addition the set is used in this position to check the batteries of the transmitters.
INTERNAL BATT TEST (S101)	Push-button switch used to test the internal batteries for proper voltage.
55.5 MC CHANNEL ADJ (C132)	Varies the amplitude of the output of the 1-f (low-frequency) channel power amplifier by changing the resonant point of the plate tank circuit of the power amplifier.
56.75 MC CHANNEL ADJ (C101)	Varies the amplitude of the output of the h-f (high-frequency) channel power amplifier by changing the resonant point of the plate tank circuit of the power amplifier.
Zero set control (R129)	Screw driver adjustment, located in a recessed hole on the front panel, used for zero setting the VTVM.
TUNE (C123)	Resonates the antenna coupling circuit for the desired channel or frequency The dial of the TUNE control is marked HI and LO, with their respective regions on the dial in black.

13. Instruments and Their Use (fig. 5)

The following table lists the instruments and indicates what they do:

Instrument	Function
Meter (M101)	Measures the signal strength of the radio transmitting equipment. Measures the signal strength delivered to the antenna coupling circuit by the test set.
BATTERY TEST lamp (I101A)	When lit, indicates that battery being tested is good.

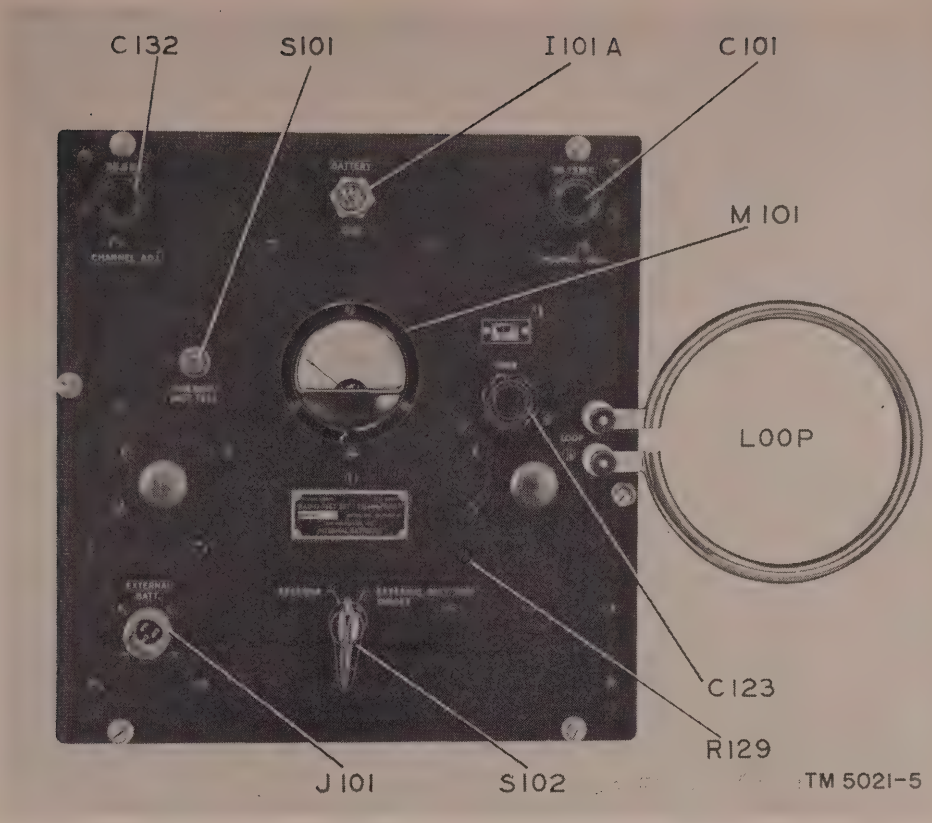


Figure 5. Radio Test Set TS–654/GRR–1, controls.

Section III. OPERATION

Note. Before every series of tests the operator should determine whether the internal batteries for the test set instrument need to be replaced. Press the INTERNAL BATT TEST switch, leaving the test selector switch (S102) in the center (OFF) position. If the BATTERY TEST indicator lights, the batteries are good. If it fails to light, the A or B or both batteries are bad. Replace each of the batteries in turn until a satisfactory battery check is obtained (par. 10). The batteries must check good before any tests are conducted.

14. Test Procedure For Glider Mounted Radio Transmitting Equipment AN/ART–4(XA–3)

a. Checking Battery Voltages. Test each of the four batteries in the following manner.

(1) Remove the cable plug from each of the batteries in the case on the nose of the glider.

(2) Plug the test cable provided into the socket designated EXTERNAL BATT on the test instrument.

(3) Plug the other end of the test cable into the battery to be tested.

(4) Turn the test selector switch (S102) to EXTERNAL BATT TEST TARGET. If the BATTERY TEST indicator lamp lights, the battery is good. If the lamp fails to light, the battery should be replaced by one which is good.

Note. In some cases it may be found that plug-in type Batteries BA–49 are not being used with the transmitters. Therefore, it will be necessary to make temporary soldered connections between the batteries and the test cable. Be sure that the connections are made to the proper pins of the test cable.

b. Peaking and Checking Frequency of Transmitter Output.

(1) Set up the test set. (See par. 10 and fig. 4.)

(2) Turn selector switch S102 to the EXTERNAL BATT TEST TARGET position, wait 10 seconds, and then adjust the meter zero control (R129) until the meter needle is at 0. Check the meter zero after every four or five tests.

Caution: Be sure that there are no signals in the 55- to 57-mc range in the immediate vicinity of the test. To detect the presence of an unwanted signal, short the terminals of the loop with a screw driver blade, adjust the meter to 0 as described above, and then see whether there is a deflection of the meter needle when the loop is unshorted. A meter needle deflection indicates the presence of an undesired signal. Make this test at 56.75 and 55.5 mc by adjusting the TUNE control (C123) to HI and LO, respectively.

(3) Connect the batteries to the high-frequency transmitter channel.

(4) Turn selector switch S102 to EXTERNAL BATT TEST TARGET and wait 10 seconds. Then tune in the signal by adjusting the knob marked TUNE until the meter reads maximum. If the index on the window does not fall within the black zone designated HI on the dial, the transmitter is off frequency and the entire transmitter must be replaced.

(5) If the transmitter is on frequency, one operator may proceed to peak the high-channel transmitter by adjusting the output trimmer, C106, of the transmitter (TM 11–893), until the other operator indicates when a maximum meter deflection has been reached.

(6) Remove the battery plugs from the high-frequency channel transmitter and connect the batteries to the low-frequency channel transmitter.

(7) Repeat the operation described in step (4) above, replacing HI with LO.

(8) Adjust output trimmer C106 of the low-frequency transmitter for maximum meter deflection.

c. Checking R-F Signal Strength.

(1) Repeat steps (1) and (2) in *b* above.

(2) Connect the batteries to both transmitters.

(3) Repeat steps (4) and (5) in *b* above, and note the peak reading of the meter. If the peak reading of the meter is less than 90, the transmitter must be replaced.

(4) Repeat steps (7) and (8) in *b* above and note the peak reading of the meter. If the peak reading of the meter is less than 90, the transmitter must be replaced.

15. Test Procedure for Flag Mounted Radio Transmitting Equipment AN/ART–4(XA–4)

a. Preparation of Flag Target for Testing. Cut the strings which bind the ends of the flag roll and carefully unroll the flag target. Suspend the flag upon a wooden rack similar to that shown in figure 6. Mount the flag so that, when the target is outstretched on the rack, the transmitters are switched on. The operator then must perform the tests as quickly as possible so as not to run down the transmitter batteries.

b. Checking Transmitter Battery Voltages. Test the two transmitter batteries by following the procedure outlined in paragraph 14*a*.

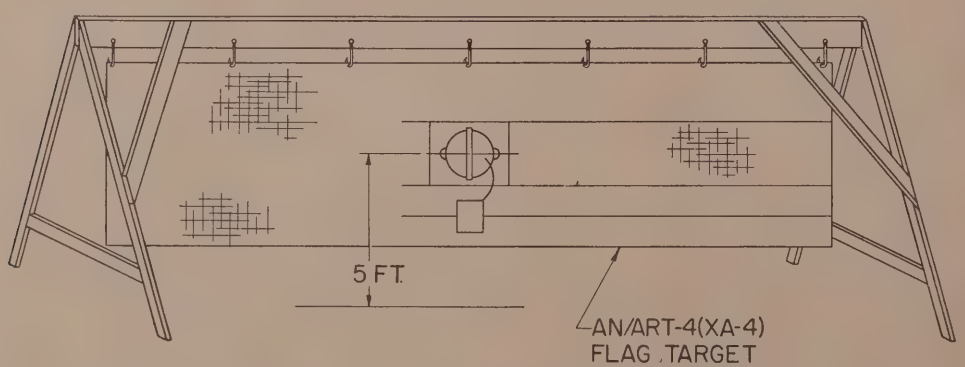


Figure 6. Rack mounting for flag targets.

c. Peaking and Checking Frequency of Transmitter Output.

(1) Set up the test set. (See par. 10 and fig. 7.)

(2) Perform the operations in paragraph 14*b* (2) through (8). If a target has a defective transmitter, replace the entire flag with one having a satisfactory unit.

d. Checking R-F Signal Strength.

(1) Set up the test set. (See par. 10 and fig. 7.)

(2) Perform the operations in steps (3) and (4) of paragraph 14*c*. If a target has a defective transmitter, replace the entire flag with one having a satisfactory unit.

Caution: After the flag has been tested, remove it from the rack as quickly as possible and relieve the tension on the switch spring.

e. Rerolling Flag. To reroll a satisfactory flag, proceed as follows:

(1) Stretch the flag out flat.

(2) Fold the trailing end over the front half. Be sure the switch cord is folded in.

(3) Roll the flag as tightly as possible, starting at the end with the transmitter.

(4) Finally, secure each end of the roll with a single strand of 25-pound test cotton string. *Do not use a heavy cord.*

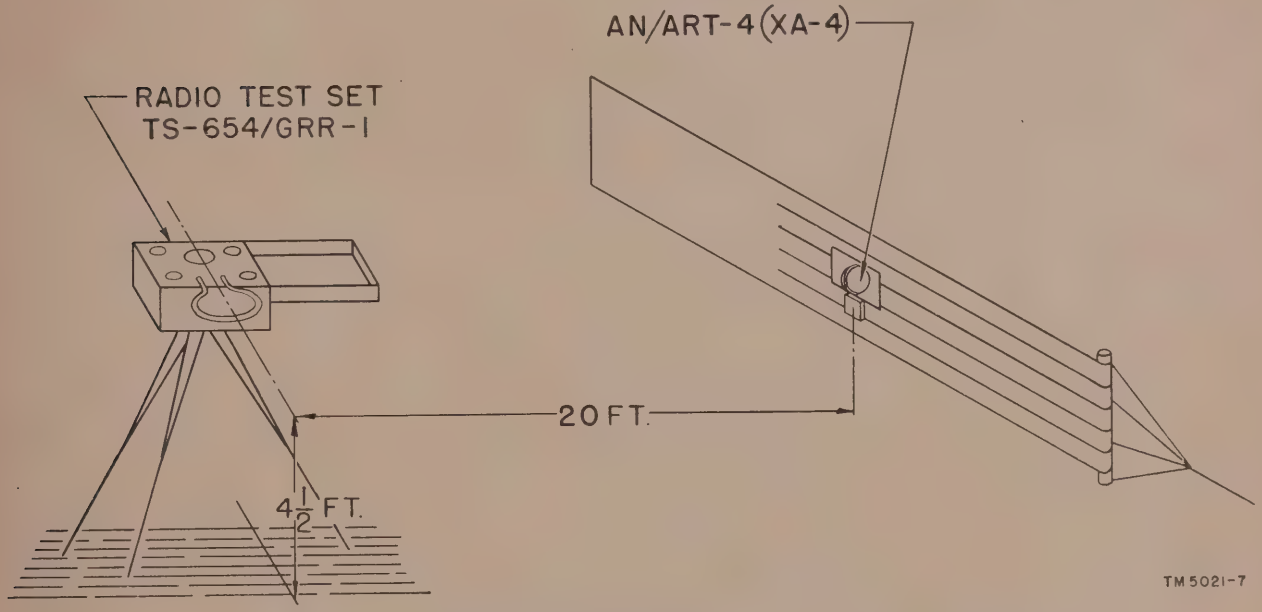


Figure 7. Testing Radio Transmitting Equipment AN/ART-4(XA-4.).

16. Test Procedure for Radio Receiving Equipment AN/GRR–1

a. Sensitivity.

(1) Set up the test set. (See par. 10 and fig. 8.)

(2) Zero-adjust the meter in the test set (par. 14*b* (2)).

(3) Adjust the TUNE control (C123) to the black section of the dial marked HI.

(4) Hold selector switch (S102) in the RECEIVER position; after 10 seconds readjust the TUNE control for maximum reading of meter M101. The index of the TUNE control must still be within the black region marked HI.

(5) Adjust the 56.75 MC CHANNEL ADJ (C101) until meter M101 reads 90.

(6) Another operator should now tune in the signal (56.75 mc) on Radio Receiver R–245/GRR–1. The receiver has adequate sensitivity when the high-channel avc meter reading is between 300 to the left of 0 and 500 to the right of 0.

(7) Test the sensitivity of Radio Receiver R–246/GRR–1 by repeating steps (1) through (5) substituting LO for HI and the 55.5 MC CHANNEL ADJ (C132)

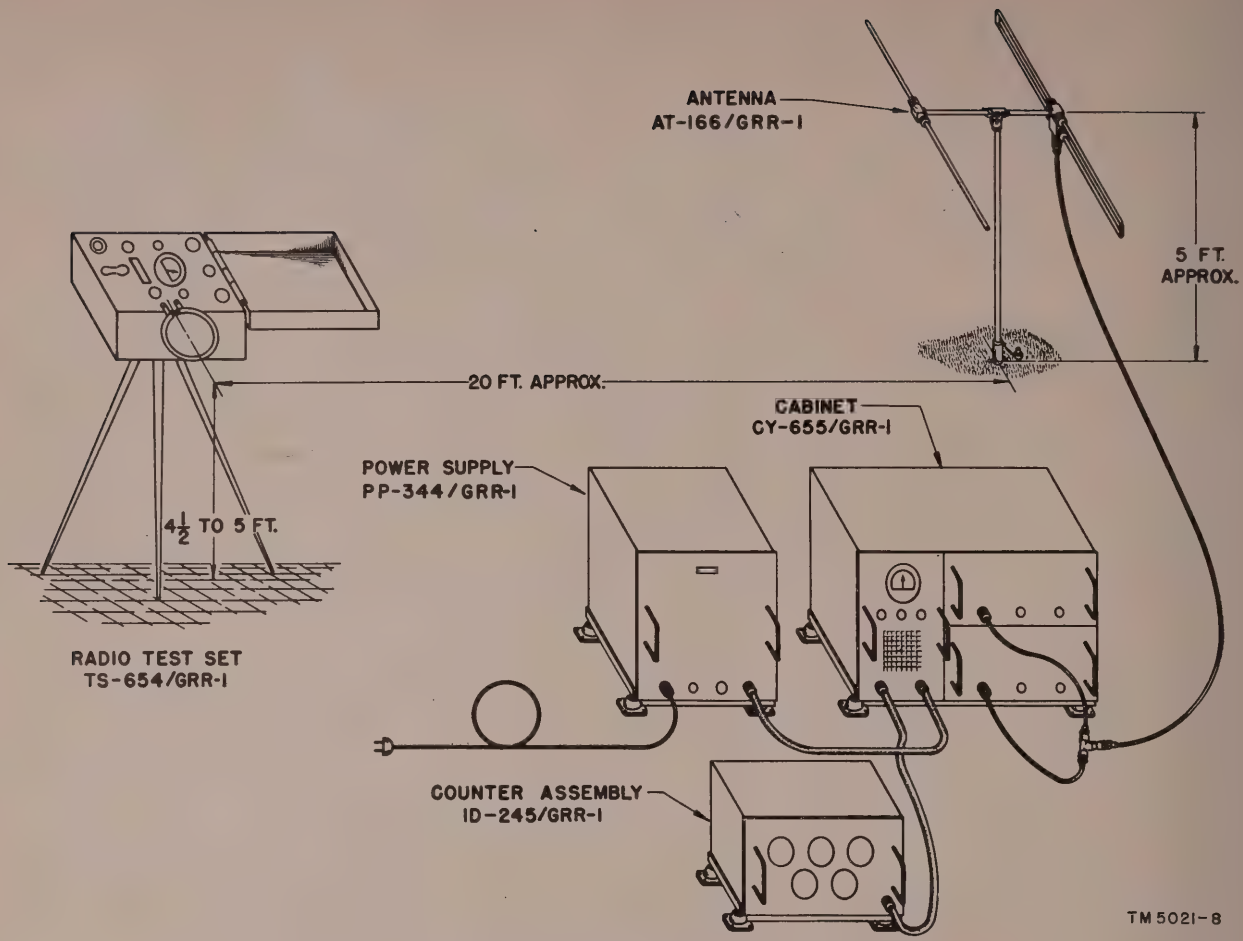


Figure 8. Testing Radio Receiving Equipment AN/GRR–1.

for the 56.75 MC CHANNEL ADJ (C101).

(8) Now tune in the signal (55.5 mc) on Radio Receiver R–246/GRR–1. The receiver has adequate sensitivity when the low-channel avc meter reading is between 300 to the left of 0 and 500 to the right of 0.

b. Zoning Operation.

(1) Move the test set as close as possible to the receiver antenna.

(2) Adjust the TUNE control (C123) until the index line is roughly halfway between HI and LO on the frequency dial.

(3) Turn selector switch (S102) to RECEIVER.

(4) If the ZONE 1 counter in Counter Assembly ID–245/GRR–1 operates, the zoning of the receiver is satisfactory.

17. Stopping Procedure

When the RECEIVER—EXTERNAL BATT TEST TARGET switch (S102) is in the center position, the test set is inoperative.

Note. If the test set is not to be used again for an extended period of time, remove the internal batteries and then repack the test set, following in reverse the procedure in paragraph 10.

18. Equipment Performance Checklist

Note. The equipment performance checklist will help the operator to determine whether the test set is functioning properly. The list gives the item to be checked, the conditions under which the item is checked, and the normal indications. The operator should check all items each time the equipment is put into operation. When the indications are not normal and the internal batteries have been checked, trouble shooting by an experienced repairman is necessary.

Item No.	Item	Action or condition	Normal indication
1	Batteries	Batteries inserted and connected to test set.	
2	Antenna	Connected to LOOP terminals	
3	TUNE control	Adjust to midpoint between HI and LO on the dial.	
4	INTERNAL BATT TEST push button.	Press button	BATTERY TEST lamp goes on.
5	RECEIVER — EXTERNAL BATT TEST TARGET switch.	Turn to EXTERNAL BATT TEST TARGET position and vary zero set control R129.	Needle of meter M101 will vary with zero set control.
6	RECEIVER — EXTERNAL BATT TEST TARGET switch.	Turn to RECEIVER position and vary the 55.5 MC CHANNEL ADJ and then the 56.75 MC CHANNEL ADJ controls.	Needle of meter M101 will vary with either of the two channel adjustment controls.
7	RECEIVER — EXTERNAL BATT TEST TARGET switch.	Center position	No reading on meter M101.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

19. Definition of Preventive Maintenance

PM (preventive maintenance) is work performed on equipment (usually when the equipment is not in use) to keep it in such good working order that break-downs and needless interruptions in service will be kept to a minimum. PM differs from trouble shooting and repair, since its object is to prevent certain troubles before they can occur.

Note. Operations described in this section are organizational maintenance (see TM 38–650).

20. Description of Preventive Maintenance Techniques

a. Use #0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts dry with a cloth.

(2) To clean electrical contacts, use a cloth moistened with carbon tetrachloride; then wipe the contacts dry with a cloth.

c. To remove dust from inaccessible places, use dry compressed air at a line pressure not exceeding 60 pounds per square inch. Be careful, or mechanical damage from the air blast may result.

21. Performing Preventive Maintenance

The PM operations described in the following subparagraphs should be performed by organizational personnel at the intervals indicated, unless these intervals are reduced by the local commander.

a. Daily.

(1) Clean the exterior of the test set.

(2) Check connections for looseness.

b. Monthly.

Caution: Disconnect all power before performing the operations which follow. Upon completion, reconnect power and check the equipment for satisfactory operation.

(1) Clean the interior of the set.

(2) Check the vacuum tubes; replace if necessary.

(3) Check the batteries for corrosion and bulging.

(4) Inspect filter capacitor C116 for leakage of dielectric, for bulging, and for heating (fig. 16).

c. Quarterly. Make a visual inspection of the following parts for the defects listed; tighten and/or clean *if necessary.*

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are destined will be damaged or broken.

(1) Tube sockets, for loose contacts, dirt, and corrosion.

(2) Filter capacitor terminals, for corrosion.

(3) Resistors, for blistering, discoloration, and other evidences of overheating.

(4) Switches, for dirt, corrosion, loose contacts, and poor action.

(5) Multiple connector, for dirt, corrosion, and loose contacts.

(6) Wires and cables, for cracked, cut, and frayed insulation.

(7) Relays, for dirt, corrosion, loose contacts, and poor action.

(8) Potentiometers, for lack of smooth electrical and mechanical operation.

(9) Mountings, machine screws, and nuts, for mechanical looseness.

(10) All visible terminals and connections, for looseness and corrosion.

(11) Moistureproof-fungiproof coatings, for breaks. (Retouch with a brush, if necessary (par. 23*b*).)

(12) Finish, for scratches and bare spots. (Retouch, if necessary.)

(13) Unshielded variable capacitors and coils, for dirt and corrosion and for bent plates and damaged turns.

(14) Insulators, for cracks and dirt.

Section II. LUBRICANTS AND PRESERVATIVES

22. Lubrication

No lubrication is required for Radio Test Set TS–654/GRR–1.

23. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, Arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is fully explained in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, and TB SIG 72, Tropical Maintenance of Ground Signal Equipment.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are fully explained in TB SIG 66, Winter Maintenance of Signal Equipment.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are fully explained in TB SIG 75, Desert Maintenance of Ground Signal Equipment.

24. Rustproofing and Painting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use #00 or #000 sandpaper to clean the surface down to the bare metal. Obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles of steel wool frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. When numerous scars and scratches warrant complete repainting, remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust, and sandpaper to complete the preparation for painting. Spray paint the case, using paint authorized and consistent with existing regulations.

CHAPTER 4

FIELD AND BASE MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field and base maintenance. The amount of repair that can be performed by units having field and base maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repair personnel.

Section I. THEORY OF RADIO TEST SET TS–654/GRR–1

25. Functions of Equipment

Radio Test Set TS–654/GRR–1 has the following functions:

a. It transmits f-m (frequency-modulated) 55.5-mc and 56.75-mc signals simultaneously. These signals are used for operational checks of Radio Receiving Equipment AN/GRR–1.

b. It receives and monitors the level of f-m 55.5-mc and 56.75-mc signals. This function provides a means of measuring the amplitude of output from Radio Transmitting Equipments AN/ART–4(XA–3) and (XA–4).

c. It provides testing facilities for checking its own battery power supply and the battery power supply of Radio Transmitting Equipments AN/ART–4(XA–3) and (XA–4).

26. Transmitting Circuit (fig. 9)

The transmitting circuit consists of two similar r-f channels, one operating at 56.75 mc, the other at 55.5 mc. Each channel utilizes a master oscillator power amplifier and a reactance modulator, V101 and V102 in the high-frequency channel and V–109 and V–107 in the low-frequency channel. A multivibrator, V103 and V104, controls the modulation of both frequencies by varying the bias on the reactance modulators at a periodic rate. Both r-f channels feed a common loop antenna by means of a common antenna coupling circuit. To allow monitoring of the output level, the antenna circuit is also coupled to a metering circuit consisting of diode detector V108, amplifier V106, and meter M101. The r-f output is rectified by the diode, the rectified signal is coupled to the amplifier, and the amplifier controls the meter current. Details of the transmitting circuit are discussed in paragraphs 29 through 33.

27. Receiving Circuit (fig. 9)

When the test set is used to peak the outputs of Radio Transmitting Equipments AN/ART–4(XA–3) and (XA–4), the transmitting circuits are disabled. The antenna, antenna coupling circuit, diode detector, VTVM amplifier, and meter M101 are then used to receive and measure incoming signal amplitudes. Refer to paragraph 33 for circuit details.

28. Power Supply and Test Circuits (fig. 9)

Dry cell batteries are used to provide filament, screen, and plate voltages for all stages of the test set by means of appropriate control circuits. The control circuits also provide a means of testing either the internal battery or the external batteries used in Radio Transmitting Equipments AN/ART–4(XA–3) and (XA–4). Circuit details are discussed in paragraph 35.

29. Master Oscillator V101A and Reactance Modulator V102 (fig. 10)

a. The circuit detail of the high-channel oscillator and reactance modulator is shown in figure 10 and is discussed in the subparagraphs which follow. Refer to the over-all schematic (fig. 20) for details of the similar circuits in the low-frequency channel. Except for the different

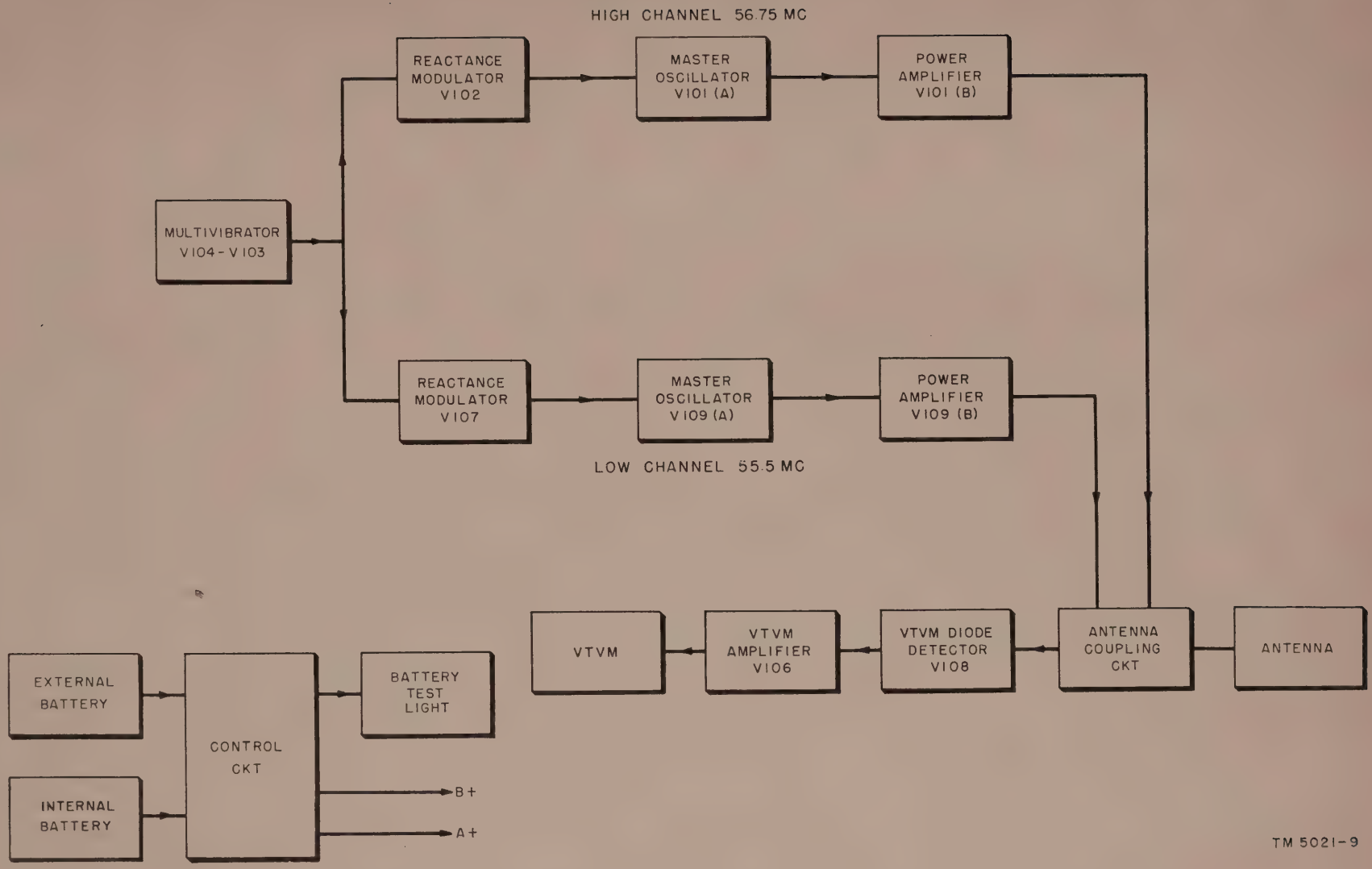


Figure 9. Radio Test Set TS-654/GRR-1, block diagram

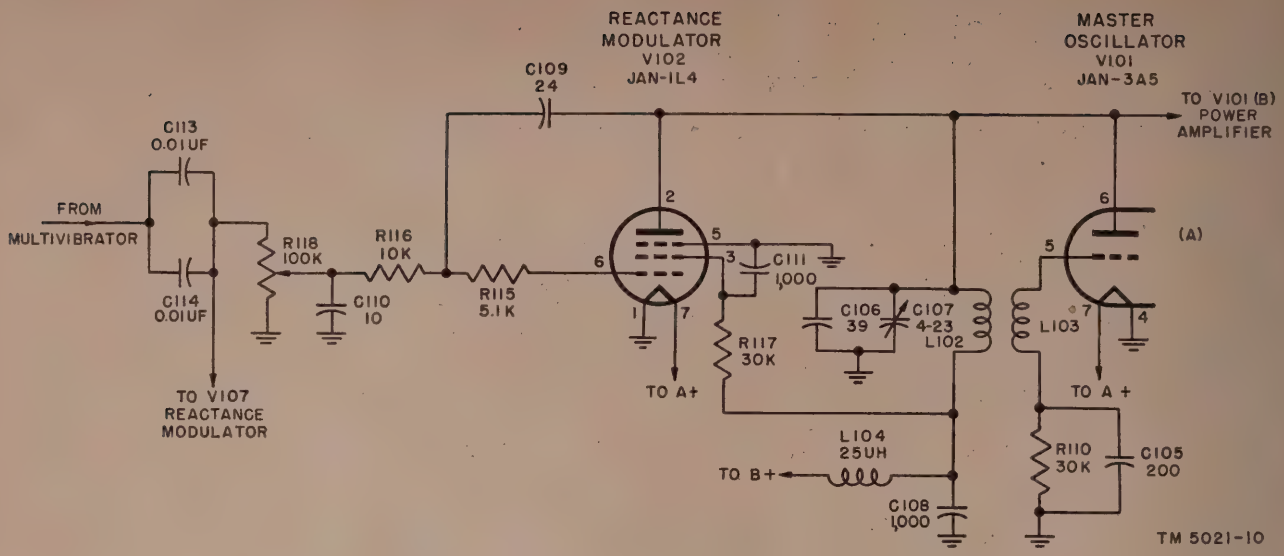


Figure 10. Reactance modulator and master oscillator, schematic diagram.

frequencies and reference symbols involved, the theory discussed here applies equally to both channels.

b. One-half of a twin triode Tube JAN–3A5, V101A, is used in the oscillator stage of the high-frequency channel; a Tube JAN–1L4 is used as a reactance modulator. A regulated 60-volt potential is supplied to the plates of these tubes through tank coil L102 and r-f choke L104. Screen voltage for the modulator, approximately 48 volts, is also obtained from the regulated supply, through dropping resistor R117. Capacitors C111 and C108 bypass the screen and plate leads, respectively. Filament voltage for both tubes, 1.5 volts, is obtained from the battery power supply (fig. 15).

c. The plate tank of the oscillator consists of inductance L102, fixed capacitor C106, variable trimmer capacitor C107, and the effective inductance of reactance modulator V102. When no modulating voltage is supplied to the reactance modulator, the effect of V102 is constant, and trimmer capacitor C107 may be adjusted to tune the oscillator to its nominal center frequency, 28.375 mc. Inductance L103 couples the plate tank to the grid of the oscillator to provide regenerative feedback for sustaining oscillations. Grid leak bias for the oscillator is developed across the R-C (resistance-capacitance) combination of resistor R110 and capacitor C105. Output from the oscillator is coupled to the power amplifier, V101B, by capacitor C104 and resistor R105 (fig. 12).

d. The effect of shunting the reactance modulator across the tank circuit is to increase the inductive current which flows through the tank circuit, the same effect which would be produced by shunting an inductance across the tank circuit. The increased inductance is effected in the following manner:

(1) The oscillator tank is coupled to the modulator grid through capacitor C109, resistor R115, and the grid-cathode capacitance of V102. Since this circuit is primarily resistive, the current through the circuit is practically in phase with the applied oscillator voltage.

(2) The voltage developed across the grid-cathode capacitance of V102 is supplied as excitation to V102. Since the voltage is developed across a capacitor, it is lagging the exciting current by 90° and, hence, is lagging the oscillator voltage by approximately 90°.

(3) The lagging grid voltage causes a lagging plate current. Since the oscillator tank is the plate load of the modulator, the lagging plate current flows through the oscillator tank. The modulator, then, is an effective inductance across the oscillator tank.

e. If the bias on the reactance modulator is decreased or increased, the inductive current flowing through the oscillator tank, will be increased or decreased, respectively, and the frequency of the oscillator will be increased or decreased correspondingly. In Radio Test Set TS–654/GRR–1,

the modified output of a multivibrator is fed to the grid of the reactance modulator, so that the modulator bias (and, hence, the frequency of the oscillator) varies at the rate of the multivibrator. The extent of the deviations depends upon the amplitude of output from the multivibrator. Capacitors C113 and C114 couple the signal from the multivibrator to amplitude control R118. Potentiometer R118 is adjusted to obtain a deviation of 100 kc. The output at the arm of the potentiometer is coupled to the grid of V102 through resistors R116 and R115 and the grid-cathode capacitance of the tube. Resistor R116 and capacitor C110 serve to isolate r-f voltage from the multivibrator output control, R118.

30. Multivibrators V103 and V104 (fig. 11).

a. A conventional free-running multivibrator is used to supply modulating voltage to the grids of the reactance modulators, V102 and V107. The modulating voltage causes frequency deviation of the transmitted signals at a 10-cycle rate, the extent of deviation depending upon the amplitude of the square-wave voltage.

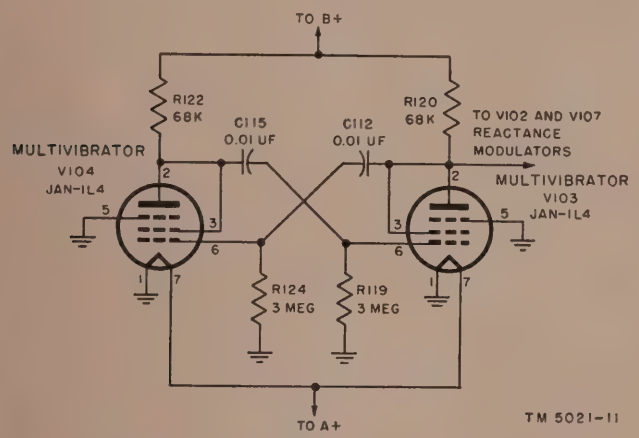


Figure 11. Multivibrator, schematic diagram.

b. The multivibrator utilizes two pentode Tubes JAN–1L4, V103, and V104. Plate and screen voltages for the tubes are obtained from the regulated 60-volt supply through load resistors R120 and R122. Filament voltage, 1.5 volts, is obtained from the battery power supply through appropriate control circuits (par. 35).

c. The frequency of oscillations (approximately 10 cycles per second) and the duration of the square-wave output pulse (approximately 50 milliseconds) are determined primarily by the interstage coupling components, resistors R119 and R124 and capacitors C112 and C115. Output is coupled from the plate of B103 through capacitors C113 and C114 to potentiometers R118 and R128 in the grid circuits of the reactance modulators (fig. 10). The time constant of the coupling circuit is such that the square-wave output of the multivibrator is differentiated, resulting in sharp positive and negative pulses of short duration (approximately 1,000 microseconds). Limiting action at the grids of the reactance modulators removes the positive pulses, so that only the negative pulses have any appreciable effect on the plate currents of the modulators. The result is negative deviations of the transmitted signals at the recurrence rate of the multivibrator, the amplitude of the deviations depending upon the adjustment of potentiometers R118 and R128. Adjustment procedure for the potentiometers is explained in paragraph 42*e*.

Note. For an analysis of a conventional multivibrator of the type used here, refer to TM 11–466, Radar Electronic Fundamentals.

31. Power Amplifier V101B (fig. 12)

a. Allowing for the difference in frequency and the different reference symbols involved, the analysis of the high-channel power amplifier (*b*, *c*, and *d* below) may also be applied to the low-channel power amplifier. The high-frequency channel is shown in figure 12; for circuit details of the low-frequency channel, refer to the over-all schematic (fig. 20).

b. One half of a twin triode Tube JAN–3A5 (V101B) is used as an amplifier and frequency doubler for the output of the high-channel master oscillator, V101A. The 28.375-mc output of the oscillator is coupled to the grid of V101B through capacitor C104 and resistor R105.

c. Grid leak bias for the power amplifier, approximately 3 volts, is developed across resistor R105. The battery power supply furnishes 1.5 volts for the filaments through appropriate control circuits (par. 35). A low value of plate voltage, approximately 36 volts, is supplied through tank coil L101B and dropping resistor R123. Capacitor C103 bypasses the plate lead.

d. The low value of plate voltage causes operation of the tube on the nonlinear portion of its characteristic curve, thus causing distortion of the input signal and a plate current rich in harmonics of the input signal. The plate circuit is tuned by inductance L101B, fixed capacitor C102, and

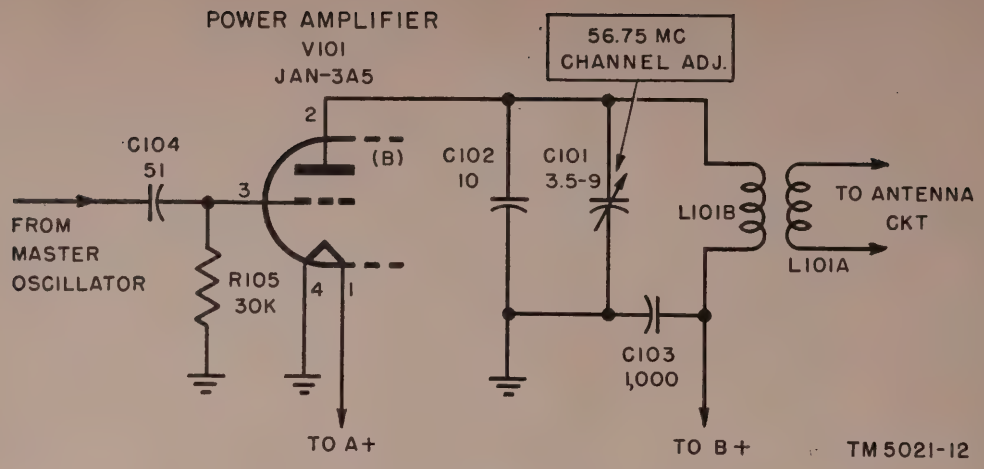


Figure. 12. Power amplifier, schematic diagram.

variable capacitor C101 to accept the second harmonic (56.75 mc) of the input signal. Capacitor C101 may be adjusted by means of a panel mounted control designated 56.75 MC CHANNEL ADJ. The output of the tank circuit is coupled by inductance L101A to the antenna coupling circuit.

32. Antenna Circuit (fig. 13)

a. The antenna circuit is common to the high-frequency and low-frequency transmitting channels and is also used as an input circuit for the VTVM diode detector when the test set is used to check the output of Radio Transmitting Equipments AN/ART–4(XA–3) and (XA–4).

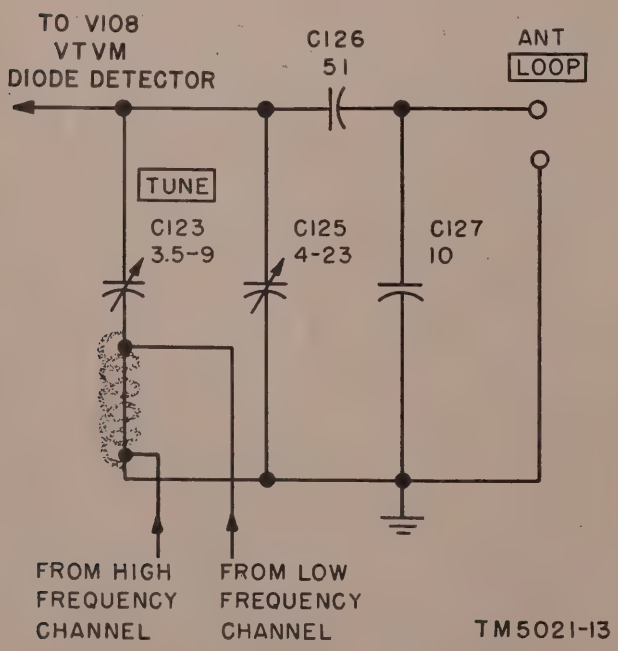


Figure 13. Antenna circuit, schematic diagram.

b. The antenna circuit consists of the loop antenna and capacitors C123, C125, C126, and C127. The loop, a high-Q single-turn inductance which mounts on the LOOP antenna terminals on the front panel of the test set, is tuned over the operating range of the test set by capacitors C123, C125, and C127. Capacitor C126 is essentially a blocking device to isolate the dc (direct current) at the plate of diode V108 from the antenna. The series fixed capacity of C127 makes the tuning effect of C126 negligible. Capacitor C125 is a trimmer used to aline the circuit to the operating range of the test set. Once C125 is adjusted, the calibrated, panel mounted TUNE control (C123) may be used to tune the test set from 55.5 ± 0.250 mc to 56.75 ± 0.250 mc.

c. The outputs of the two r-f channels are loosely coupled to the antenna circuit, the distributed inductance of ground leads being utilized for coupling purposes. This is shown diagrammatically in figure 13. The ground lead on C123 is represented as having distributed inductance; the output lead of the low-frequency channel is connected to one point on the ground lead, and the output of the high-frequency channel is connected to a lower point on the ground lead. The purpose of the different points of connection is to insure equal signal strength at both frequencies. The distributed inductance offers higher reactance to the high-frequency signal than to the low-frequency signal. If both signals were fed at the same point, the high-channel frequency would develop a stronger signal in the antenna circuit.

d. The signal developed in the antenna circuit by the output of the r-f channels is transmitted by means of the loop antenna. When the test set is used for checking Radio Transmitting Equipments AN/ART–4(XA–3) and (XA–4), the signals picked up by the loop are developed in the antenna circuit. Whether the test set is transmitting or receiving, the output of the antenna circuit is always coupled to the VTVM diode detector, V108.

33. VTVM Diode Detector V108 (fig. 14)

a. The purpose of the VTVM diode detector is to rectify the output of the antenna circuit (either transmitted signal or received signal) so that the signal level may be measured in the VTVM stage, V106.

b. A diode Tube JAN–1A3 is used for the VTVM diode detector, V108. The output of the antenna circuit is coupled to the plate and cathode of the diode, the cathode pin being grounded. Filament voltage, 1.5 volts, is supplied from the battery power supply through appropriate control circuits (par. 35). When the output of the antenna circuit is positive at the plate of V108, the diode conducts and develops the rectified signal across series resistors R134 and R133. The signal developed across resistor R133 is filtered by capacitor C118 and supplied to the gride of the VTVM amplifier, V106.

34. VTVM Amplifier V106 (fig. 14)

a. The VTVM amplifier, V106, utilizes a twin triode Tube JAN–3A5 to control the current through a microammeter, M101. The two sections of the triode are connected in a bridge circuit, the meter being connected across the output of the bridge. Input to the stage is supplied by the VTVM diode detector, V108. When there is no output from the antenna circuit, the output of the detector (input to the VTVM amplifier) is zero. Under these conditions the bridge is balanced, and there is no indication on the meter. When there is output from the antenna circuit, the signal at the grid, pin 5, of V106 causes one section of the triode to draw more current than the other. The bridge balance is then upset, and the meter reading is proportional to the strength of the grid signal. Circuit details are discussed in *b* below.

b. Filament voltage for V106 (1.5 volts) is obtained from the battery power supply through appropriate control circuits (par. 35). Plate voltage, approximately 38 volts, is obtained

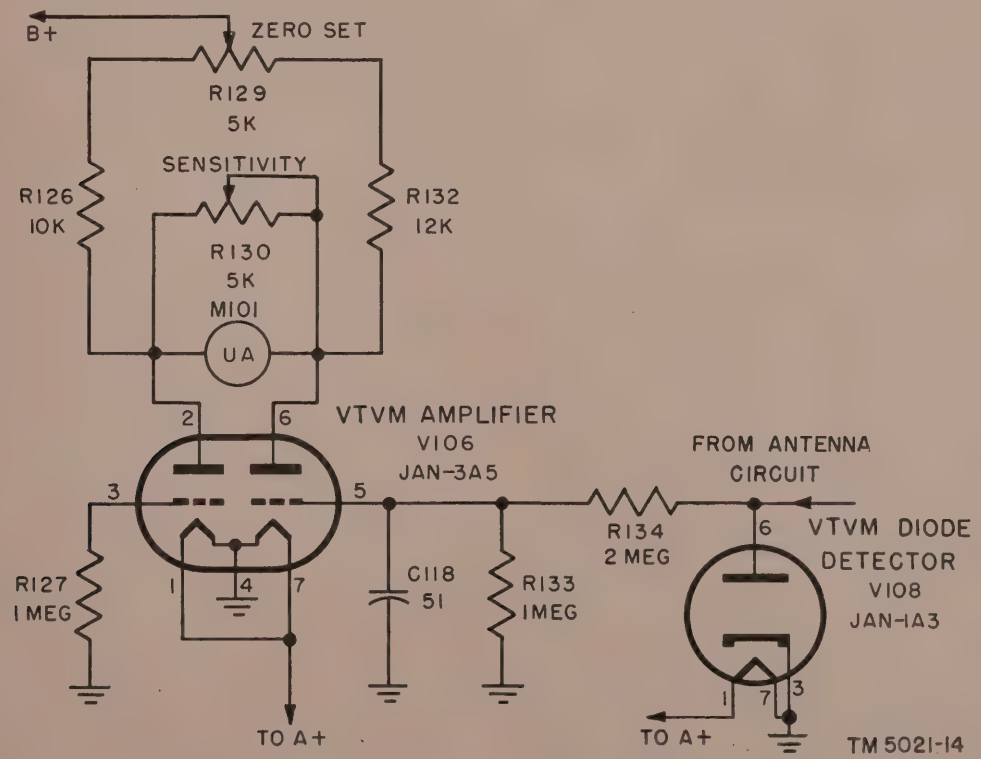


Figure 14. VTVM diode detector and amplifier, schematic diagram.

from the regulated supply through potentiometer R129, resistor R126, and resistor R132. R129, R126, and one section of V106 (pins 2, 3, and 4) constitute one leg of the bridge. The other leg of the bridge utilizes the second section of the triode (pins 4, 5, and 6), resistor R132, and, in common with the first leg, potentiometer R129. The grids, pins 3 and 5, of the tube are returned to ground through resistors R127 and R133.

c. Potentiometer R129 is a zero-set control for the meter and is adjusted so that, with no signal input to the stage, equal currents will flow in each leg of the bridge. The meter, connected between the two plates of the tube, will then draw no current. If a signal is applied to pin 5 of the tube, one section of the tube (and, hence, one leg of the bridge) will draw more current than the other section. There then will be a difference of potential between the plates of the tube, and current will flow through the meter. The setting of potentiometer R130, which is shunted across the meter as a sensitivity control, determines how much current will flow through the meter. The control is normally adjusted so that a potential of 0.1 volt rms across the antenna circuit will cause a current of 20 microamperes to flow through the meter.

35. Power Supply, Control, and Battery Test Circuits (fig. 15)

a. Receiver—External Batt Test Target Switch. Operation of the test set is controlled by a panel mounted, 6-pole, 3-position spring-return type switch (S102) designated RECEIVER—EXTERNAL BATT TEST TARGET. The normal resting (center) position of the switch is undesignated and is used for testing the internal battery supply of the test set (*c* below). Operation of the test set as a transmitter, to check operation of Radio Receiving Equipment AN/GRR–1, is controlled by the RECEIVER position of S102 (*d* below); operation of the test set as a receiver and external-battery tester, to check operation of Radio Transmitting Equipments AN/ART–4 (XA–3) and (XA–4), is controlled by the EX-

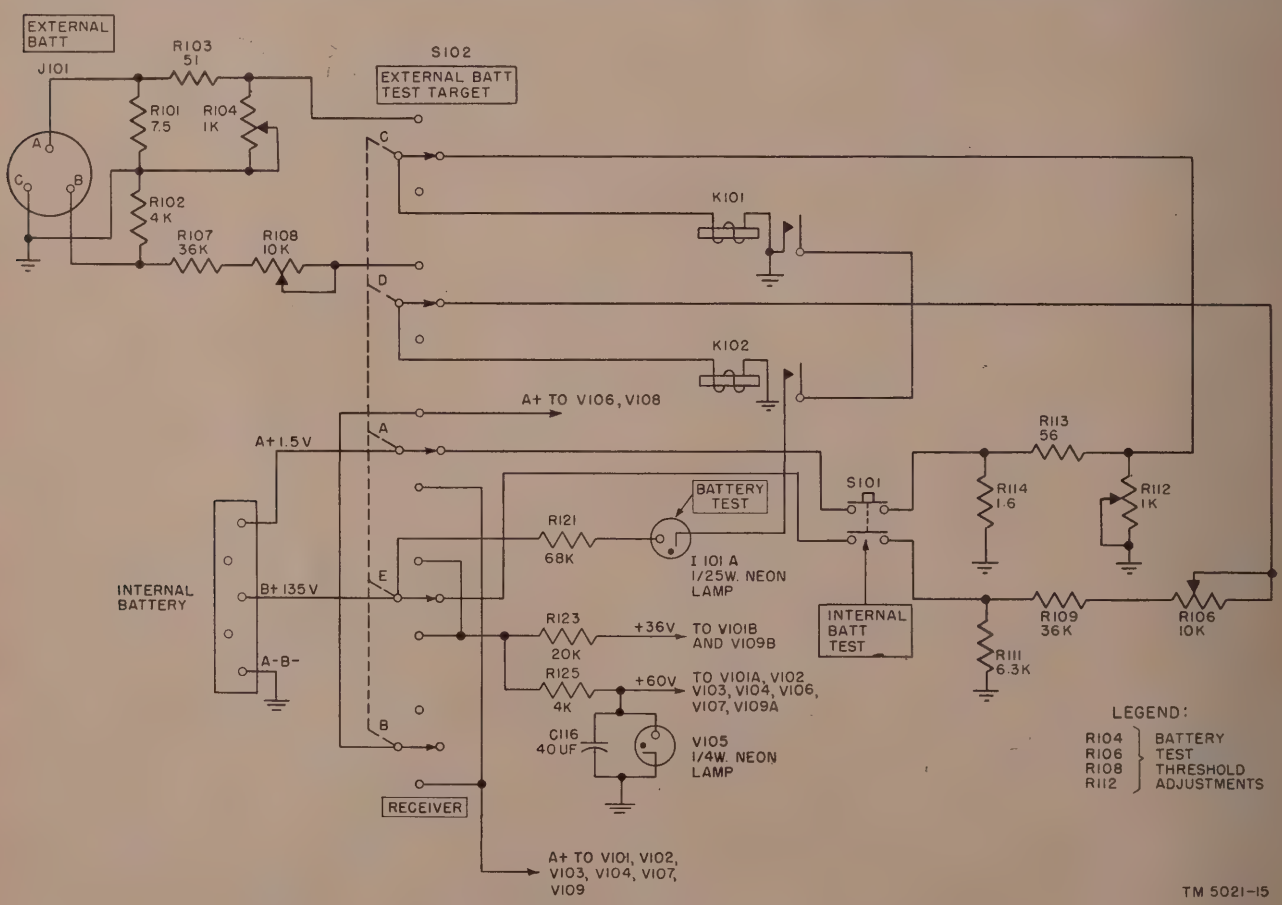


Figure 15. Power supply, control, and battery test circuits, schematic diagram.

TERNAL BATT TEST TARGET position of the switch (*e* below).

b. Equipment Power Sources. Two dry cell Batteries BA–51 are connected in series to furnish a 135-volt d-c plate and screen supply for the tubes of the test set; a dry cell Battery BA–15–A is used to furnish 1.5 volts for the filaments. When the batteries are installed in the equipment, the 135-volt potential is available at the moving contact of section E on S102; the 1.5-volt potential is available at the moving contact of section A on S102.

c. Center Position of S102. When S102 is left in the center position, the only function of the test set is to check its own battery power supply. The A+ lead of Battery BA–15–A is connected through section A of S102 to contacts of the momentary INTERNAL BATT TEST switch, S101; the B+ lead of Battery BA–51 is connected through section E of S102 to another set of contacts on S101. The B+ lead is also connected to the BATTERY TEST LAMP (I101A) through dropping resistor R121. When S101 is pressed, the A+ potential is connected to the coil of relay K101 through a resistive load and current limiting circuit (resistors R114 and R113 and potentiometer R112) and section C of S102. Adjustment of R112 controls the amount of current which will flow through the relay. If the battery potential is sufficient to energize the relay, a contact will close in the circuit of the BATTERY TEST lamp. The B+ potential is connected to the coil of relay K102 through the other set of contacts on S101, and another resistive load and current limiting circuit (resistors R111 and R109, and potentiometer R106), and section D of S102. Adjustment of R106 determines the amount of current which will flow through K102. If the B+ potential is sufficient to energize K102, a contact will close in the circuit of the BATTERY TEST lamp. This contact is in series with the contact of K101, and both contacts must be closed to complete a circuit for the BATTERY TEST lamp. Hence, if either of the batteries is below normal operating potential, one of the relays will not operate and the circuit to the BATTERY TEST lamp will remain open. The threshold of operation for relays K101 and K102 (and, hence, the sensitivity of the battery testing circuit) is determined by the setting of potentiometers R112 and R106. Adjustment of the potentiometers is described in paragraph 42.

d. Receiver Position of S102. When S102 is held in the RECEIVER position, the following potentials are supplied to the various tubes:

(1) Filament voltage is supplied to all tubes through sections A and B of the switch.

(2) Plate voltage, approximately 36 volts, is supplied to the power amplifier sections of V101 and V109 through section E of the switch and dropping resistor R123.

(3) Plate and screen voltages, approximately 60 volts, for the remaining tubes are supplied through section E of the switch and dropping resistor R125. To maintain a constant 60-volt potential despite varying load currents and aging batteries, a neon glow tube (V105) and capacitor C116 are connected in parallel between the 60-volt potential and ground. If the load current increases, the tube current decreases and the total current through resistor R125 remains the same; if the load current decreases, tube current increases, so that the total current through R125 still remains constant. Variations of battery voltage are compensated for similarly.

e. External Batt Test Target Position of S102. When held in the EXTERNAL BATT TEST TARGET position, S102 (section E) duplicates the B+ connections of the RECEIVER position; filament voltage, however, is removed from all tubes except the VTVM diode detector and VTVM amplifier, V106 and V108, by means of sections A and B of the switch. Only these stages are used when checking or tuning Radio Transmitting Equipments AN/ART–4(XA–3) and (XA–4). Sections C and D of the switch connect relays K101 and K102 to the external-battery testing circuit. The external batteries which are to be tested must be connected to the EXTERNAL BATT jack, J101; the A battery between pins A and C (ground) on the jack and the B battery between pins B and C. Resistors R101 and R103 and potentiometer R104 constitute the load and current limiting network for the A battery; resistors R102 and R107 and potentiometer R108 constitute the load and current limiting network for the B battery. Adjustments of potentiometers R104 and R108 (par. 42) set the operating thresholds of relays K101 and K102, respectively, when external batteries are being tested. If the battery potentials are normal, the relays will operate and the BATTERY TEST lamp will light, just as for internal battery testing.

Section II. PREREPAIR PROCEDURES

36. Test and Repair Equipment

a. Tools and Materials. The usual tools and materials such as are contained in the individual radio repairman's Tool Equipment TE–113 (Signal Corps stock No. 6R38113) are required for reconditioning, adjusting, and repairing Radio Test Set TS–654/GRR–1.

b. Test Equipment.

Signal Corps stock No.	Name of test equipment	Used to—
3F4325–352	Multimeter TS-352/U, or equal	Check against voltage-resistance charts.
	Electronic Multimeter TS-505/U (vacuum-tube voltmeter), or equal.	Test high-impedance circuits.
3F5700–177	Tube Tester I–177, or equal	Test tubes.
3F4325–497	Signal Generator TS–497/URR, or equal	Substitute signals.
3F4325–174	Frequency Meter TS–174/U, or equal	Test frequency of r-f output.

37. Stripping, Cleaning, Inspecting, and Testing

a. Stripping. Remove the unit from the case by following the procedure in paragraph 10*a*.

b. Cleaning. Remove all batteries and tubes and clean the test set. Refer to paragraph 20 for cleaning materials and instructions.

c. Inspecting. The source of trouble may be determined by a visual inspection of the test set. Inspect the set as follows:

(1) Examine for burned insulation and resistors. Examine for wax leakage and any discoloration of apparatus and wire.
(2) Inspect for broken connections to tube sockets, plugs, and other parts, as well as for defective soldered connections. Examine for bare wires touching the chassis or other wires.
(3) Check the tubes for incorrect tube numbers.
(4) Inspect the relays for pitted contacts.
(5) Inspect the battery terminals for corrosion.
(6) Inspect the variable resistors and capacitors for lack of smooth operation.
(7) Inspect the selector switch for loose or bent parts. Be sure that the switch operates satisfactorily.
(8) Inspect for loose or missing screws, bolts, and nuts.

d. Testing. Test all the tubes either by substitution or with a tube tester.

Section III. TROUBLE SHOOTING AND REPAIR

38. Trouble-shooting Procedures

The first step in servicing a defective piece of electronic equipment, such as this test, is to sectionalize the fault. Sectionalization means tracing a fault to the *component* or *circuit* responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing a fault to the defective *part* responsible for the abnormal condition. Some faults, such as burned-out resistors and overheated transformers, can be located by sight or smell. The majority of faults, however, must be located by checking each part for proper operation.

a. Sectionalization. Careful observation of the performance of the set may sectionalize a fault to a particular section or stage. Further observation and voltage measurements are necessary to determine which stage in the particular section is at fault. After the trouble has been sectionalized to a specific stage, the part that is faulty can be found by localization.

b. Localization. A detailed voltage-resistance check of the defective stage will help locate the faulty circuit. Compare the readings observed with the normal readings shown in the voltage and resistance charts (par. 40). An analysis of the circuit at fault will determine which part is bad.

39. Sectionalization and Localization

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the following trouble-shooting data:

Fig. No.	Description
16	Radio Test Set TS–654/GRR–1, bottom view.
17	Radio Test Set TS–654/GRR–1, bottom view with battery plate removed.
20	Radio Test Set TS–654/GRR–1, schematic diagram.
21	Radio Test Set TS–654/GRR–1, wiring diagram.

a. To sectionalize trouble in the test set, perform the steps in the following chart:

Action	Symptom	Stage or stages involved
Press INTERNAL BATT TEST button	BATTERY TEST lamp does not light.	Internal batteries, control circuits, lamp (I101A).
Turn selector switch S102 to RECEIVER position	No reading on meter M101	VTVM stage, 55.5-mc channel, 56.75-mc channel.
Turn selector switch to EXTERNAL BATT TEST TARGET position, and supply a 55.5-mc signal to the antenna from Signal Generator TS–497/URR.	No reading on meter M101	VTVM stage.
Turn selector switch to RECEIVER position	Low reading on meter M101	55.5-mc channel, 56.75-mc channel.
Vary the 55.5 MC CHANNEL ADJ. with S102 in RECEIVER position.	Meter reading does not vary with adjustment.	55.5-mc channel.
Vary the 56.75 MC CHANNEL ADJ. with S102 in RECEIVER position.	Meter reading does not vary with adjustment.	56.75-mc channel.

b. When the trouble is in more than one stage, take voltage and resistance measurements of the stages involved. Meter readings that do not agree with the normal readings show which stage is at fault. The determination of which part is faulty is accomplished by detailed voltage and resistance measurements in the stage.

40. Voltage and Resistance Charts

a. Typical Voltage Readings.

Notes. 1. Readings taken with a 20,000-ohm-per-volt voltmeter.
2. Readings raken between indicated point and ground.
3. S102 in RECEIVER position.

Ref symbol	Tube JAN–	Function	Pin No.						
			1	2	3	4	5	6	7
V101	3A5	H-f mopa	1.5	36	*—3.2	0	*—1.8	60	1.5
V102	1L4	Reactance modulator	0	60	48	60	0	*0	1.5
V103	1L4	Multivibrator	0	40	40	60	0	*—7.5	1.5
V104	1L4	Multivibrator	0	40	40	60	0	*—7.5	1.5
V105	991 Neon	Voltage regulator	0	60					
V106	3A5	VTVM	1.5	38	*0	0	*0	38	1.5
V107	1L4	Reactance modulator	0	60	48	60	0	*0	1.5
V108	1A3	Diode rectifier	1.5	0	0			0	0
V109	3A5	L-f mopa	1.5	60	*—1.8	0	*—3.2	36	1.5

*Readings taken with a VTVM.

b. Typical Resistance Readings.

Notes. 1. Resistance to ground; S102 in center position.
2. K=1,000 ohms.
3. Batteries disconnected.

Ref symbol	Tube JAN–	Function	Pin No.						
			1	2	3	4	5	6	7
V101	3A5	H-f mopa	1	*20K	30K	0	30K	*4K	1
V102	1L4	Reactance modulator	0	*4K	*35K	*4K	0	65K	1
V103	1L4	Multivibrator	0	*75K	*75K	*4K	0	3 meg	1
V104	1L4	Multivibrator	0	*75K	*75K	*4K	0	3 meg	1
V105	991	Voltage regulator	0	*4K					
	Neon			500K					
V106	3A5	VTVM	1	*11K	1 meg	0	1 meg	*11K	0
V107	1L4	Reactance modulator	0	*4K	*35K	*4K	0	65K	1
V108	1A3	Diode rectifier	1	3 meg	0			3 meg	0
V109	3A5	L-f mopa	1	*4K	30K	0	30K	*20K	1

*Resistance to B+ terminal 135 volts (RED) with battery disconnected and S102 in RECEIVER position.

Section IV. ALINEMENT PROCEDURES

41. Test Equipment Required

a. D-c calibrated voltage source, 1.0 to 1.5 and 110 to 140 volts. Meter Test Set TS–682/GSM–1 (part of Meter Test Equipment AN/GSM–1), Signal Corps stock No. 3F4325–682, or equal.

b. Frequency Meter TS–174/U, or equal.

c. VTVM, r-f, 55.5 mc, 0 to 1 volt, or equal.

d. Radio Receivers R–245/GRR–1 and R–246/GRR–1, or equal.

e. Signal Generator TS–497/URR, or equal.

42. Alinement and Adjustment Procedures

a. Adjustment of Battery Test Circuit.

(1) Apply 1.2 volts dc to terminals A+ and A— of the internal battery cable.
(2) RECEIVER — EXTERNAL BATT TEST TARGET switch in the center position.
(3) INTERNAL BATT TEST push button depressed.
(4) Adjust R112 until relay K101 just closes (fig. 17).
(5) Apply 115 volts dc to terminals B+ and B— of the internal battery cable.
(6) Adjust R106 until relay K102 just closes (figs. 16 and 17).
(7) Apply 1.4 volts dc to terminals A and C of the EXTERNAL BATT plug (J101).
(8) RECEIVER — EXTERNAL BATT TEST TARGET switch in the EXTERNAL BATT TEST TARGET position.
(9) Adjust R104 until relay just closes (fig. 17).
(10) Apply 120 volts dc to terminals B and C of the EXTERNAL BATT plug (J101).
(11) Adjust R108 until relay K102 just closes (figs. 16 and 17).

b. Alinement of Antenna Circuit.

(1) Set Signal Generator TS–497/URR or equal to 55.5 mc and couple the generator to the antenna loop.
(2) Set TUNE control C123 to LO position.
(3) Set S102 in EXTERNAL BATT TEST TARGET position.
(4) Tune capacitor C125 for maximum indication of meter M101 (fig. 17).

c. Adjustment of VTVM Sensitivity.

(1) Connect a VTVM capable of measuring 0.1 volt rms at 55.5 mc to the antenna LOOP terminals.
(2) Set Signal Generator TS–497/URR or equal to 55.5 mc and loosely couple the generator to the antenna loop.
(3) Set TUNE control C123 to LO position.
(4) Apply enough signal from the generator to cause a 0.1-volt rms deflection of the VTVM.

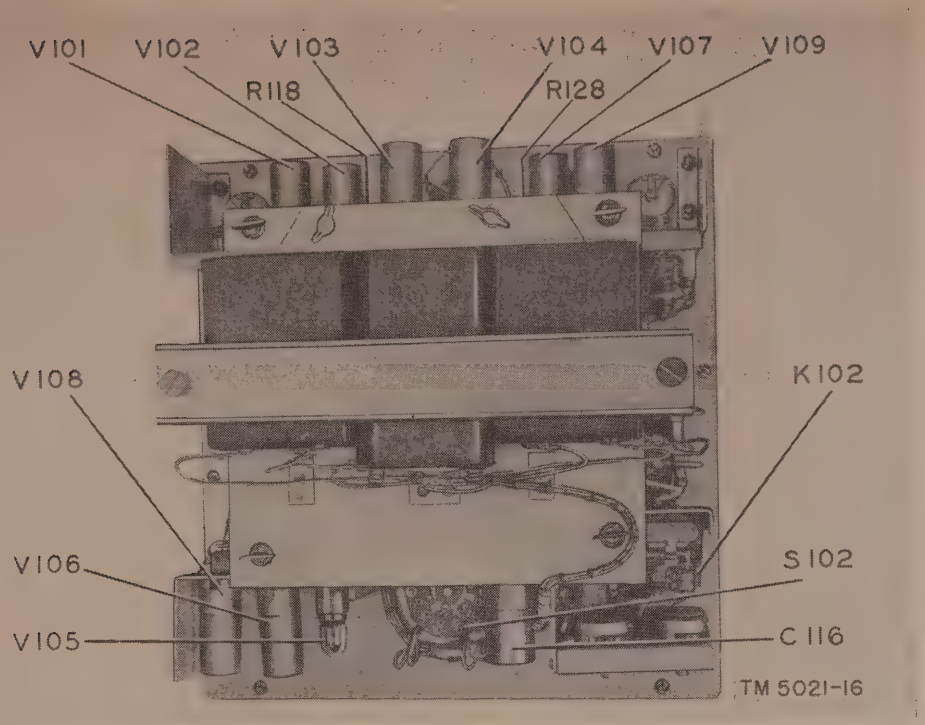


Figure 16. Radio Test Set TS–654/GRR–1, bottom view.

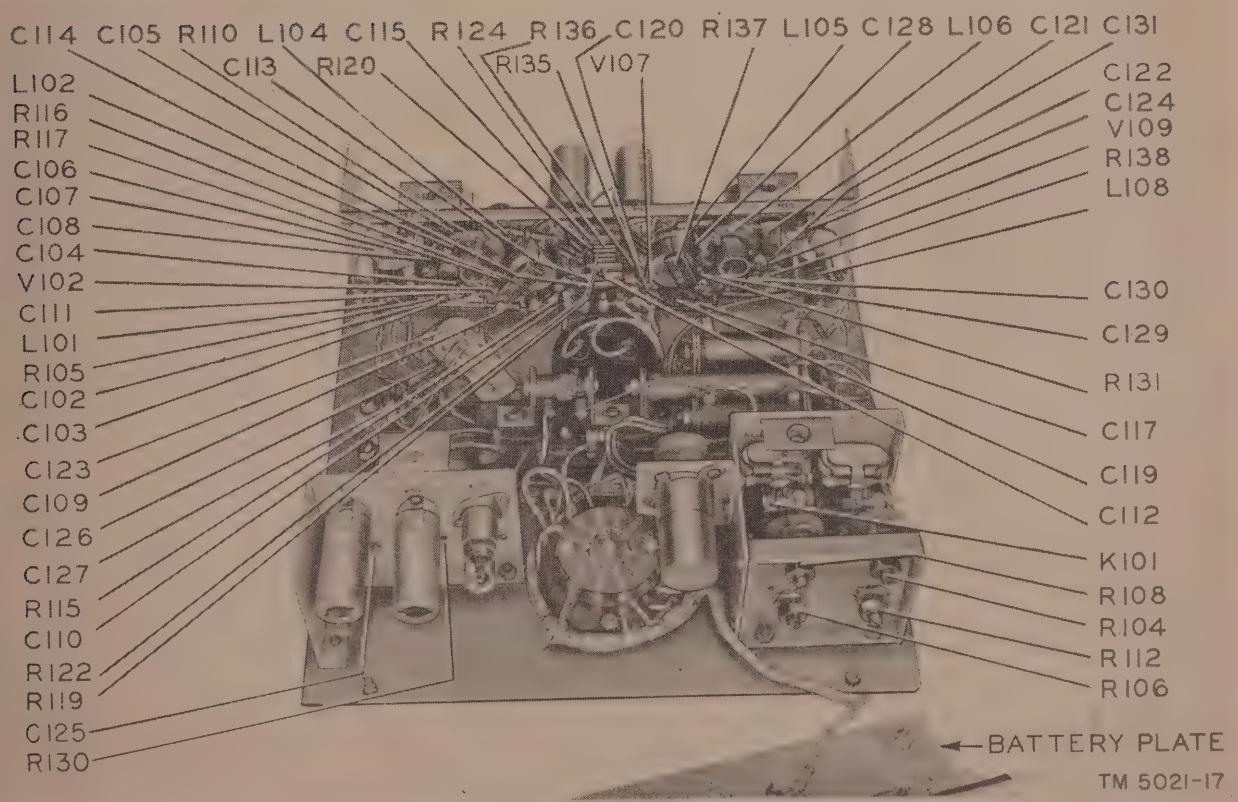


Figure 17. Radio Test Set TS–654/GRR–1, bottom view with battery.

(5) Adjust sensitivity control R130 until meter M101 reads 20 microamperes (fig. 17).

d. Alinement of Oscillator Circuits.

(1) Tune calibrated Radio Receivers R–246/GRR–1 and R–245/GRR–1 to 55.5 and 56.75 mc, respectively.

(2) Set up the receivers and the test set as shown in figure 8.

(3) Set switch S301 of Radio Receiver R–245/GRR–1 to TUNE position.

(4) Set TUNE control of the test set to HI.

(5) Set R118 in the test set so that no signal is fed from the multivibrator to the inductance modulator or remove tube V103 (fig. 16).

(6) Set MONITOR switch S101 in the Range Computer CP–51/GRR–1 to HI.

(7) Adjust C107 in the test set for 0 (center of discriminator characteristic) indication on meter M101 in Range Computer CP–51/GRR–1.

(8) Set switch S201 of Radio Receiver R–246/GRR–1 to TUNE position.

(9) Set R128 in the test set so that no signal is fed from the multivibrator to the reactance modulator, or remove tube V103 (fig. 16).

(10) Set TUNE control of test set to LO.

(11) Set MONITOR switch S101 in Range Computer CP–51/GRR–1 to LOW.

(12) Adjust C122 in the test set for 0 indication on meter M101 in Range Computer CP–51/GRR–1.

e. Adjustment of Multivibrator. The output controls (R118 and R128) of the multivibrator must be adjusted to obtain 100-kc deviations of the transmitted signals. The adjustment procedure requires the use of a Radio Receiving Equipment AN/GRR–1 which has been standardized by Radio Test Set TS–655/GRR–1 as outlined in steps (1) and (2) below.

(1) Calibrate Radio Test Set TS–655/GRR–1 to generate a 56.75-mc signal. Adjust the deviation controls of the test set for a deviation of 100 kc. (Refer to TM 11–5022.) Feed this signal to Radio Receiving Equipment AN/GRR–1, and adjust output control R347 in Radio Receiver R–245/GRR–1 until the ZONE 1 counter just operates.

(2) Calibrate Radio Test Set TS–655/GRR–1 to generate a 55.5-mc signal with 100-kc deviations. Feed this signal to Radio Receiving Equipment AN/GRR–1, and adjust output control R247 in Radio Receiver R–246/GRR–1 until the ZONE 1 counter just operates.

(3) Set up Radio Test Set TS–654/GRR–1 and Radio Receiving Equipment AN/GRR–1 as outlined in pragraph 16*b*. Place the test set TUNE control in the HI position.

(4) Adjust potentiometer R128 for zero deviation of the low-frequency signal (extreme counterclockwise position of the control), or remove the low-frequency power amplifier tube (V109) from the test set.

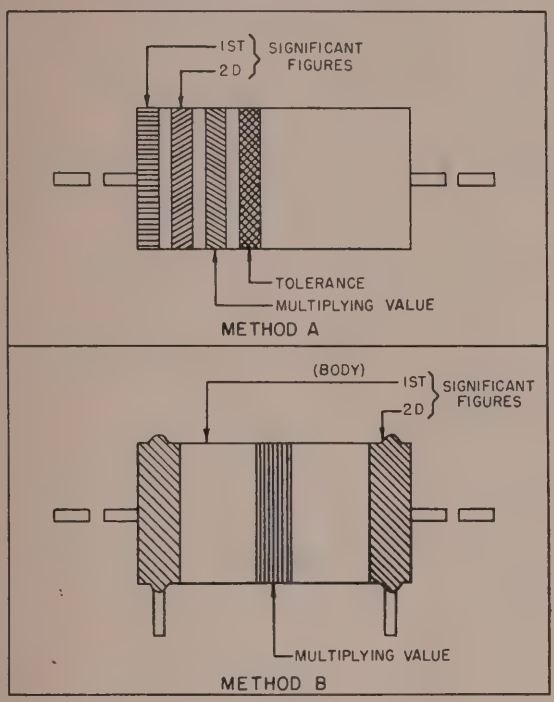
(5) While holding selector switch S102 in the RECEIVER position, adjust potentiometer R118 until the ZONE 1 counter of Radio Receiving Equipment AN/GRR–1 just operates. The high-frequency channel is then calibrated for 100-kc deviations.

(6) Place the TUNE control in the LO position and replace tube V109 if it has been removed. Remove tube V101. Turn potentiometer R128 in a clockwise direction until the ZONE 1 counter again operates. The low-frequency channel then is standardized for 100-kc deviations. Replace V101.

Note. After the adjustments are completed, it will be necessary to restandardize Radio Receiving Equipment AN/GRR–1 before it can be used for target practice operations.

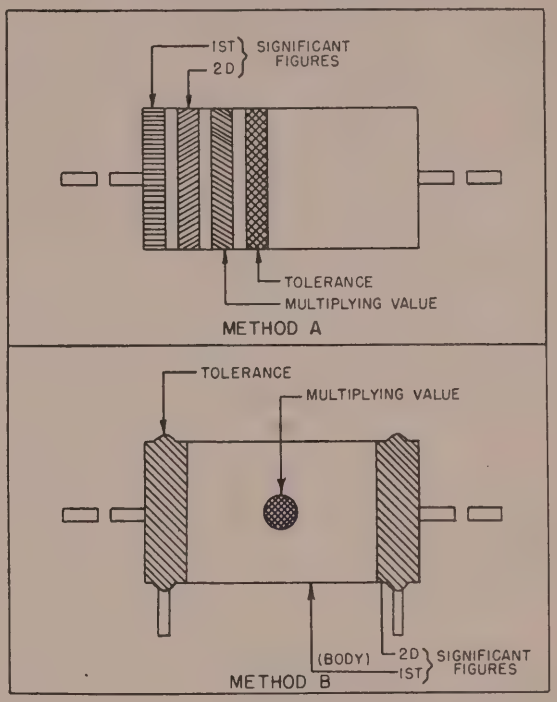
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*



A

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS/



B

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)
BLACK	0	1	± –
BROWN	1	10	± 1
RED	2	100	± 2
ORANGE	3	1,000	± 3
YELLOW	4	10,000	± 4
GREEN	5	100,000	± 5
BLUE	6	1,000,000	± 6
VIOLET	7	10,000,000	± 7
GRAY	8	100,000,000	± 8
WHITE	9	1,000,000,000	± 9
GOLD	–	0.1	± 5
SILVER	–	0.01	± 10
NO COLOR	–	–	± 20

NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.

/ RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED

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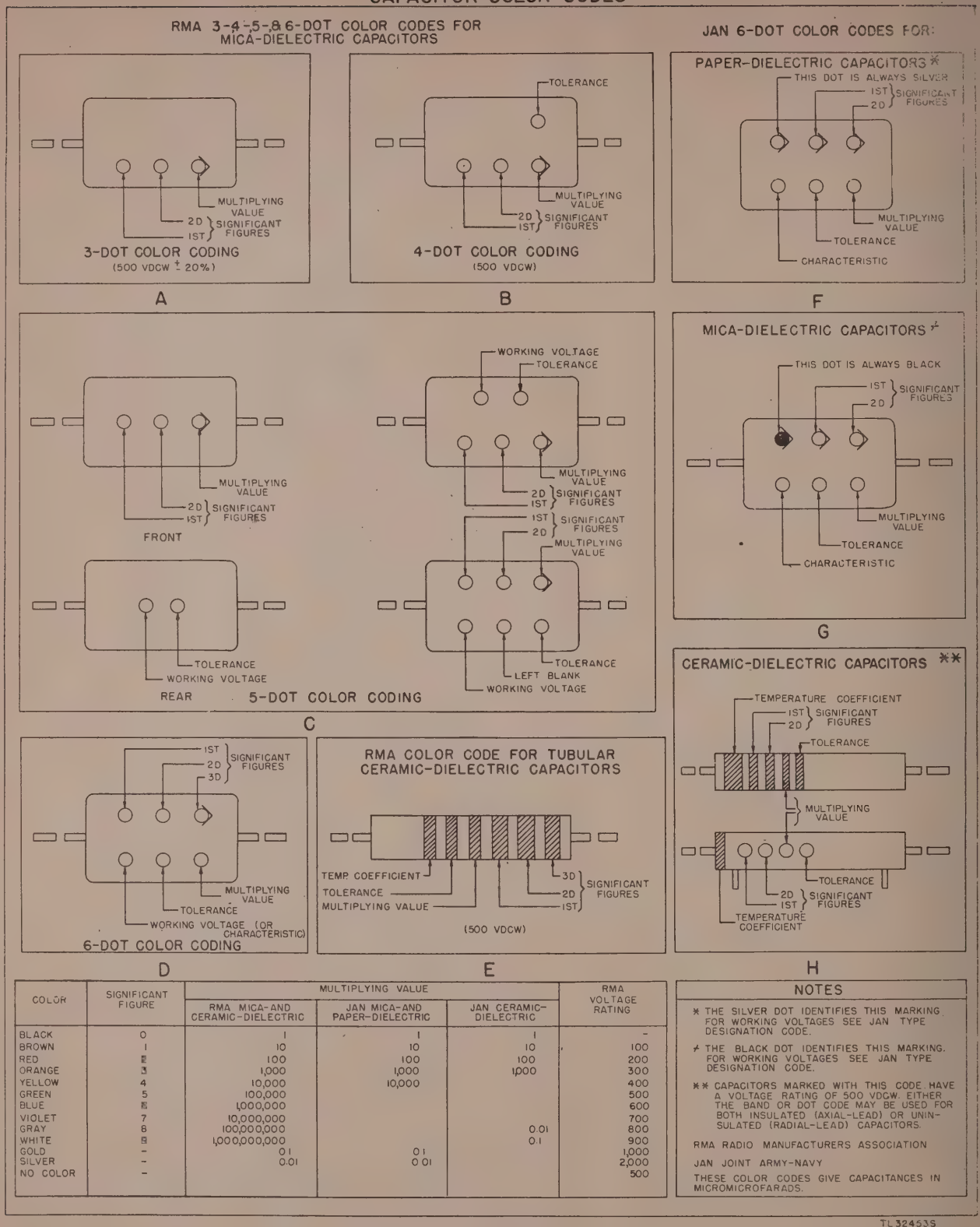
JAN. JOINT ARMY-NAVY

THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS

TL32454S

Figure 18. Resistor color codes

CAPACITOR COLOR CODES



COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA-AND CERAMIC-DIELECTRIC	JAN MICA-AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	-
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000		400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	-	0.1	0.1		1,000
SILVER	-	0.01	0.01		2,000
NO COLOR	-				500

NOTES

* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

≠ THE BLACK DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS.

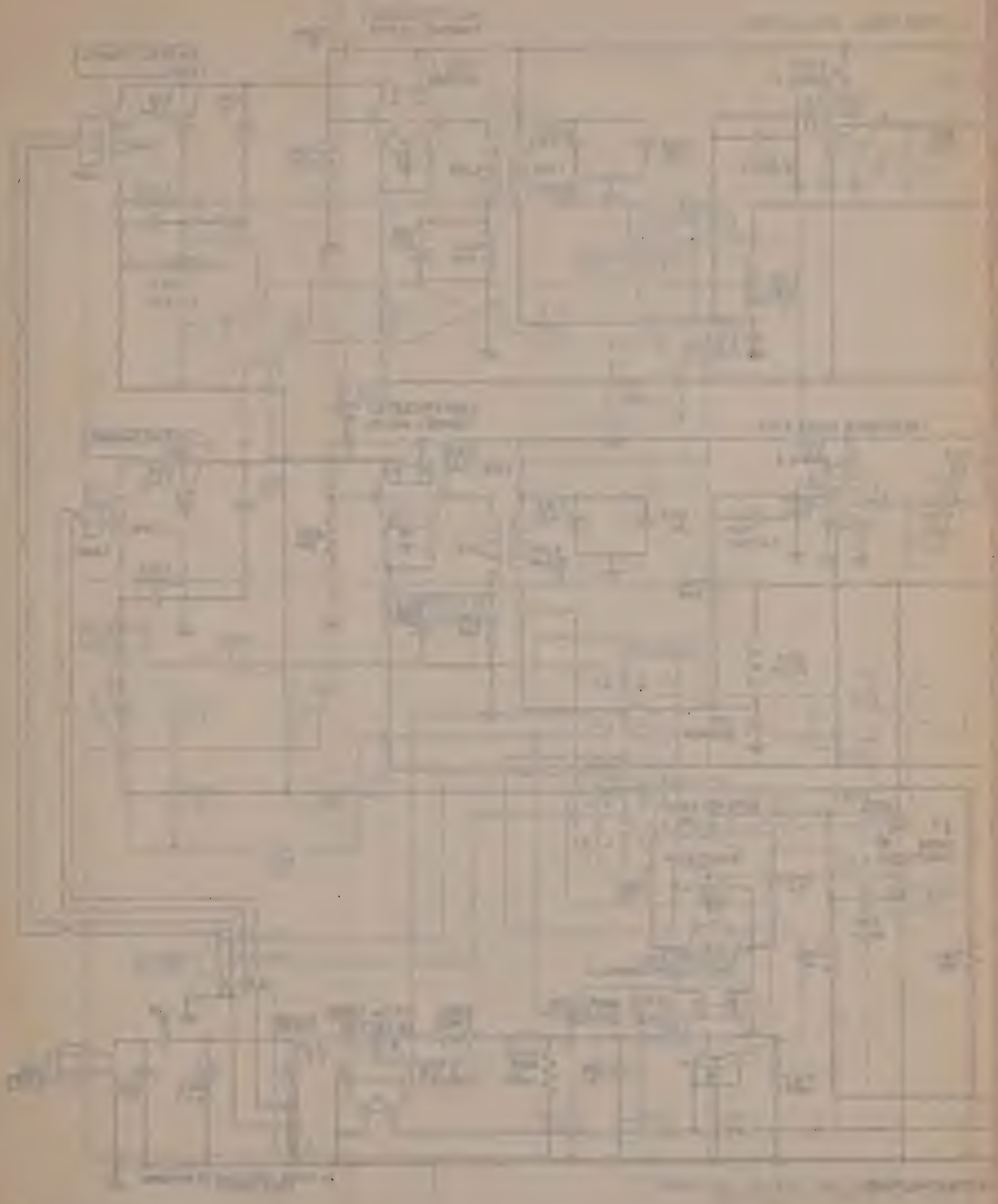
RMA RADIO MANUFACTURERS ASSOCIATION

JAN JOINT ARMY-NAVY

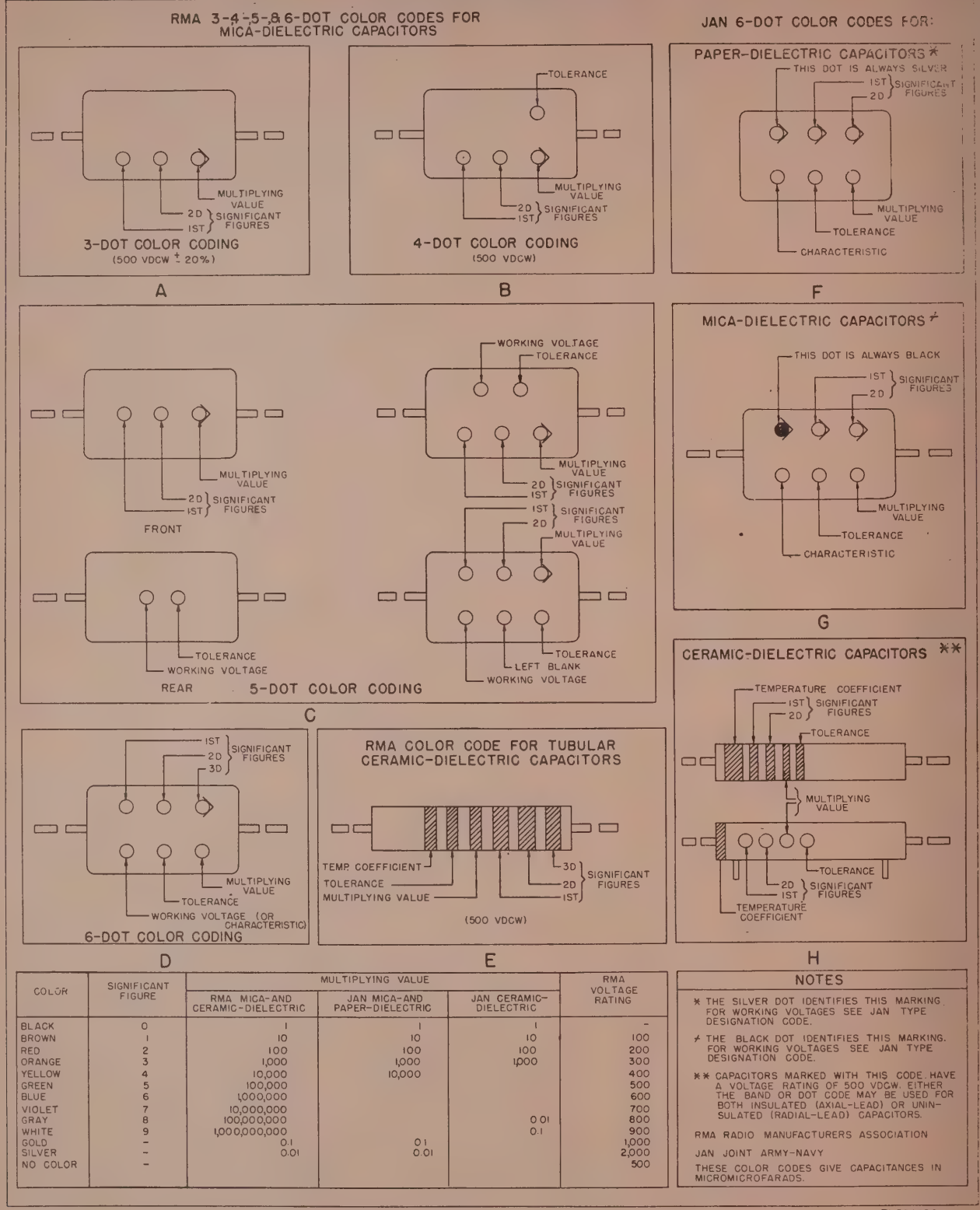
THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS.

TL 32453S

Figure 19. Capacitor color codes.



CAPACITOR COLOR CODES



COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA- AND CERAMIC-DIELECTRIC	JAN MICA- AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	-
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000		400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	-	0.1	0.1		1,000
SILVER	-	0.01	0.01		2,000
NO COLOR	-				500

NOTES

* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

≠ THE BLACK DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS.

RMA RADIO MANUFACTURERS ASSOCIATION

JAN JOINT ARMY-NAVY

THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS.

TL 32453S

Figure 19. Capacitor color codes.

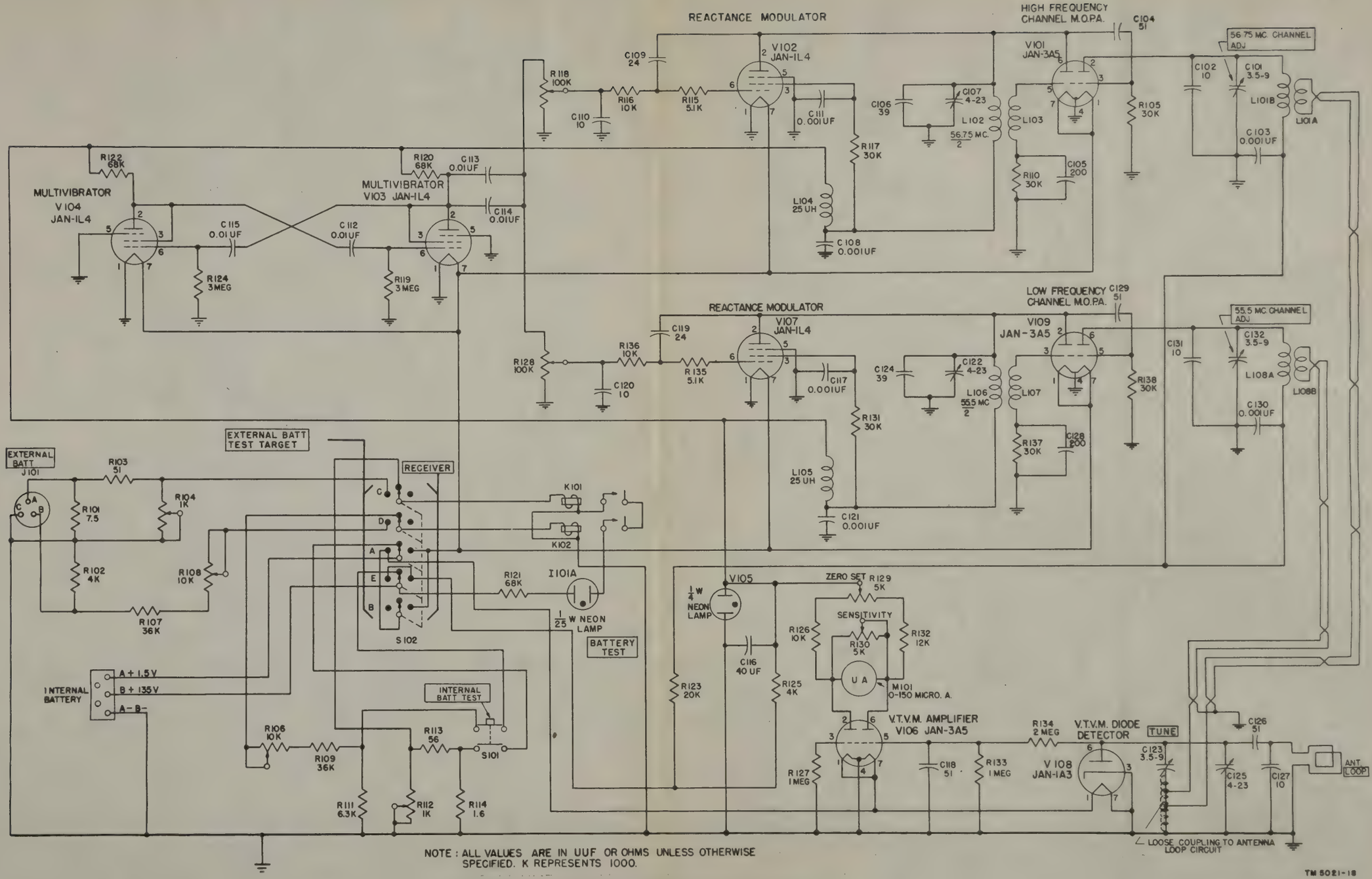
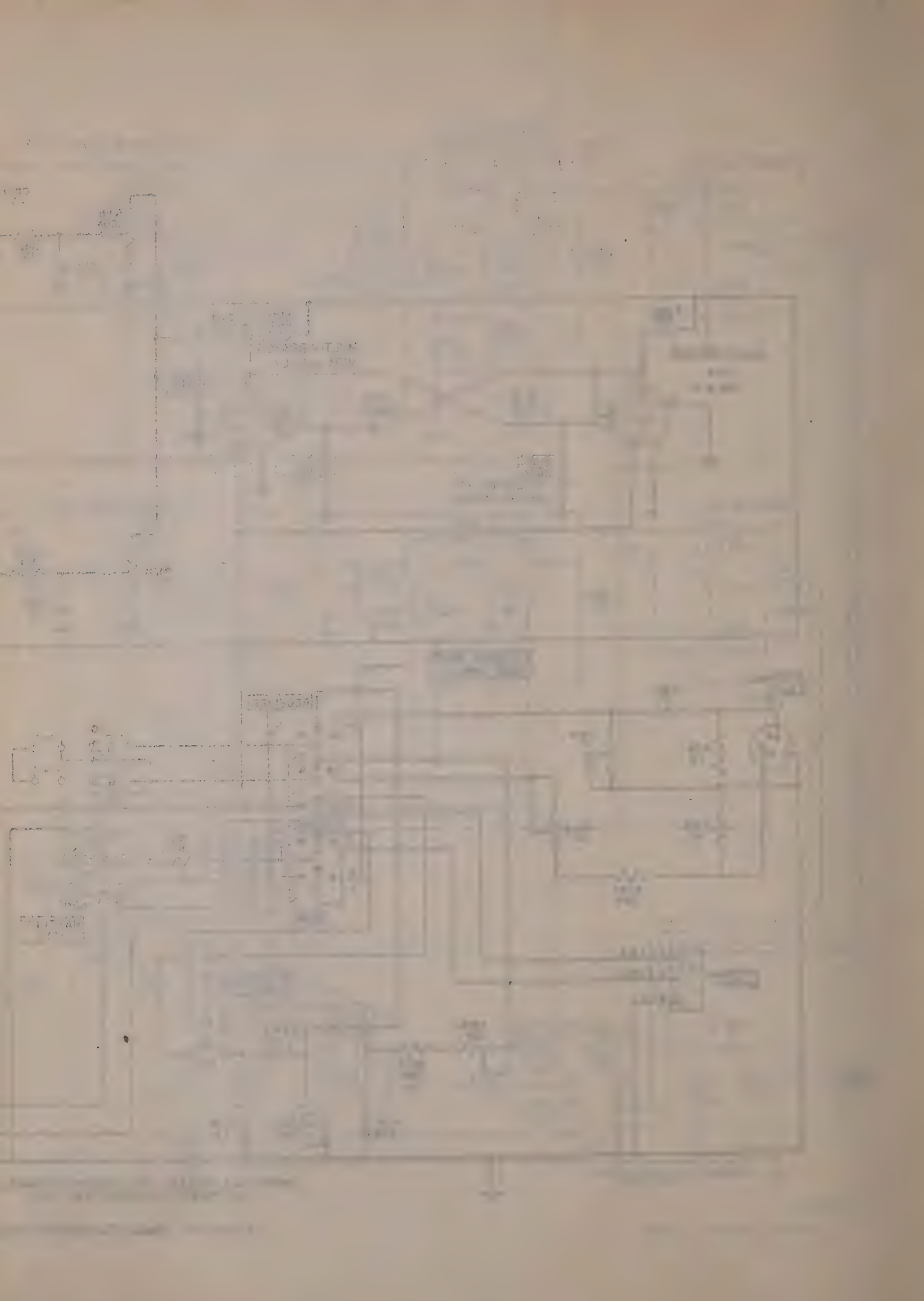
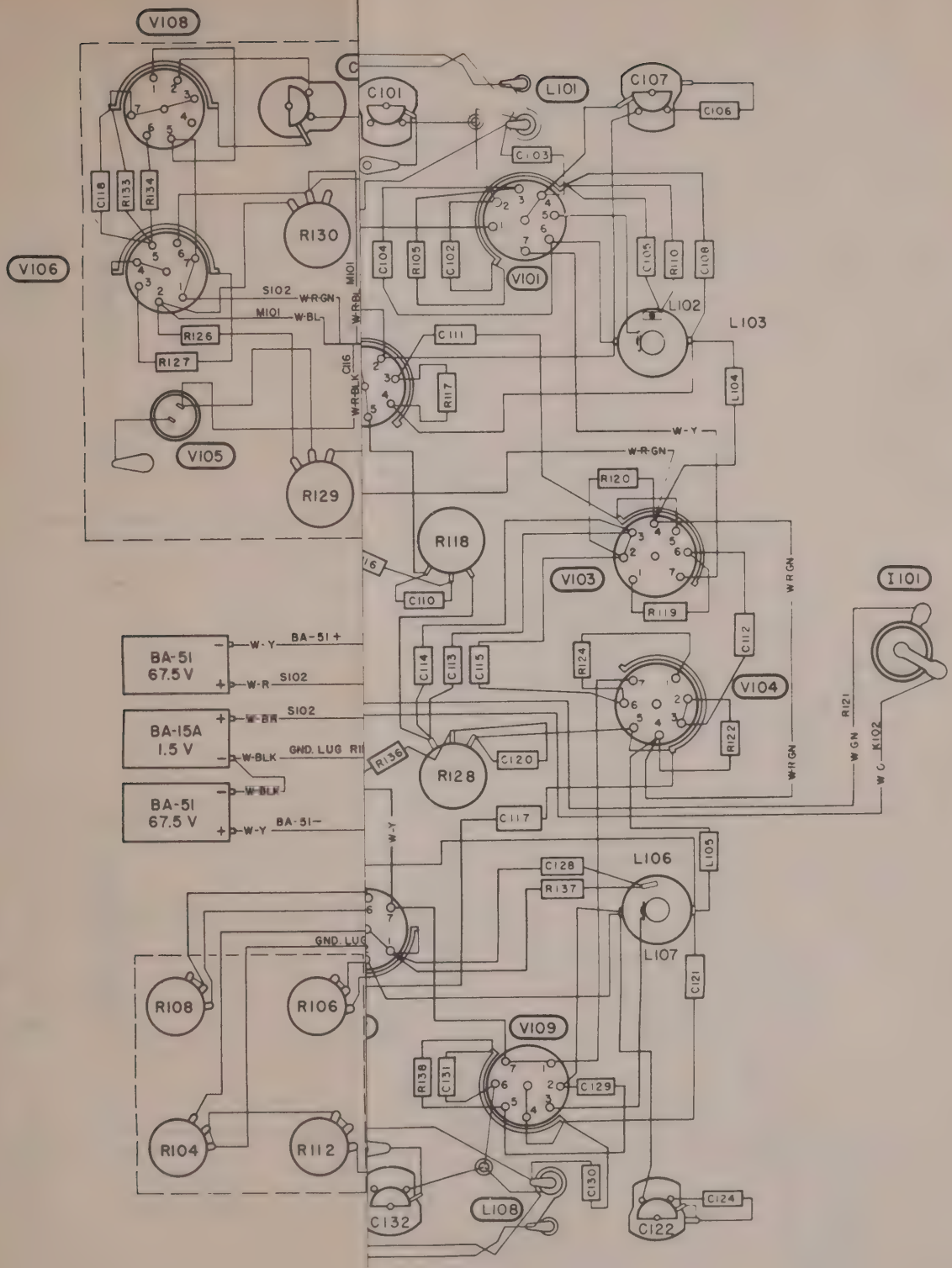
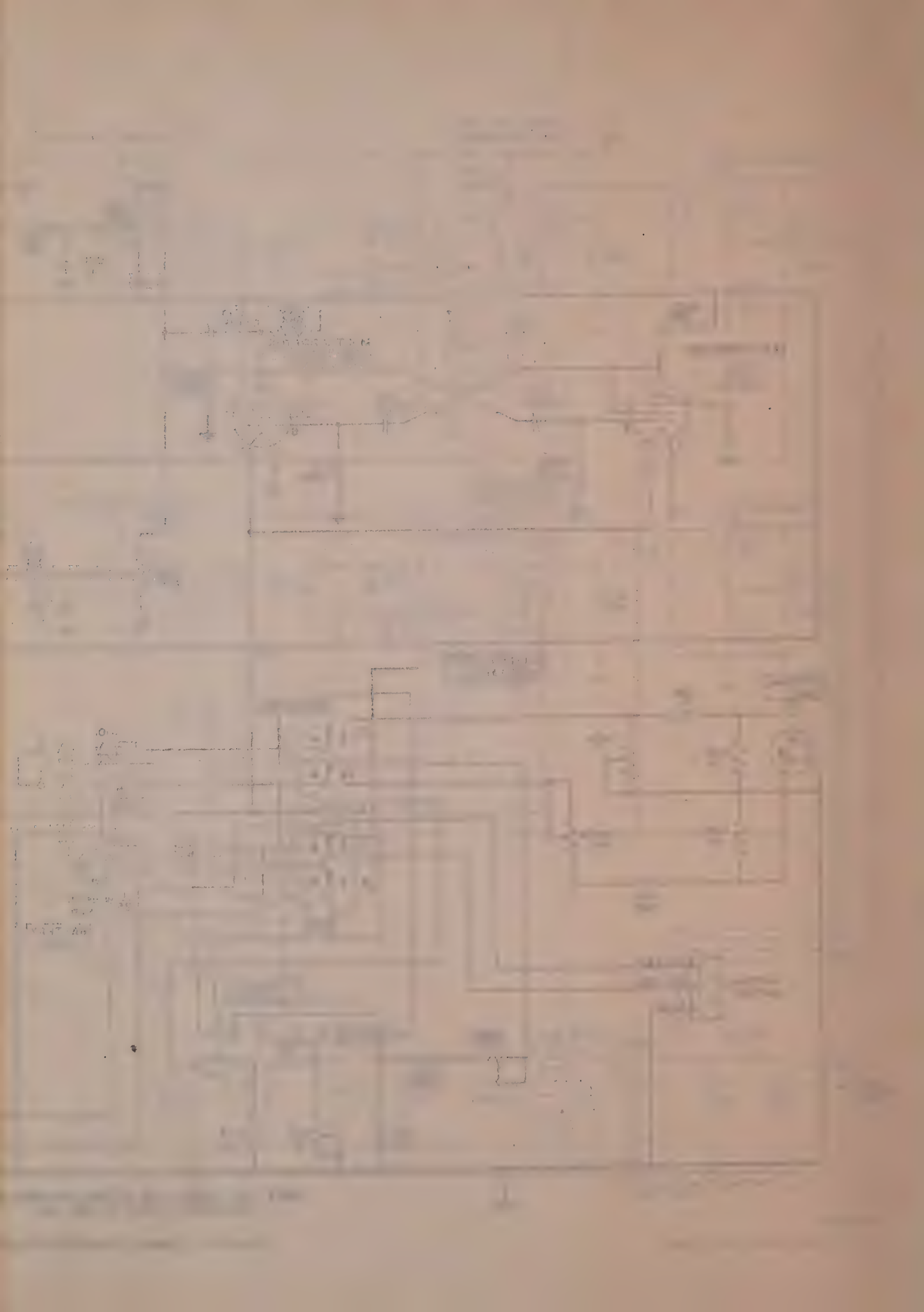


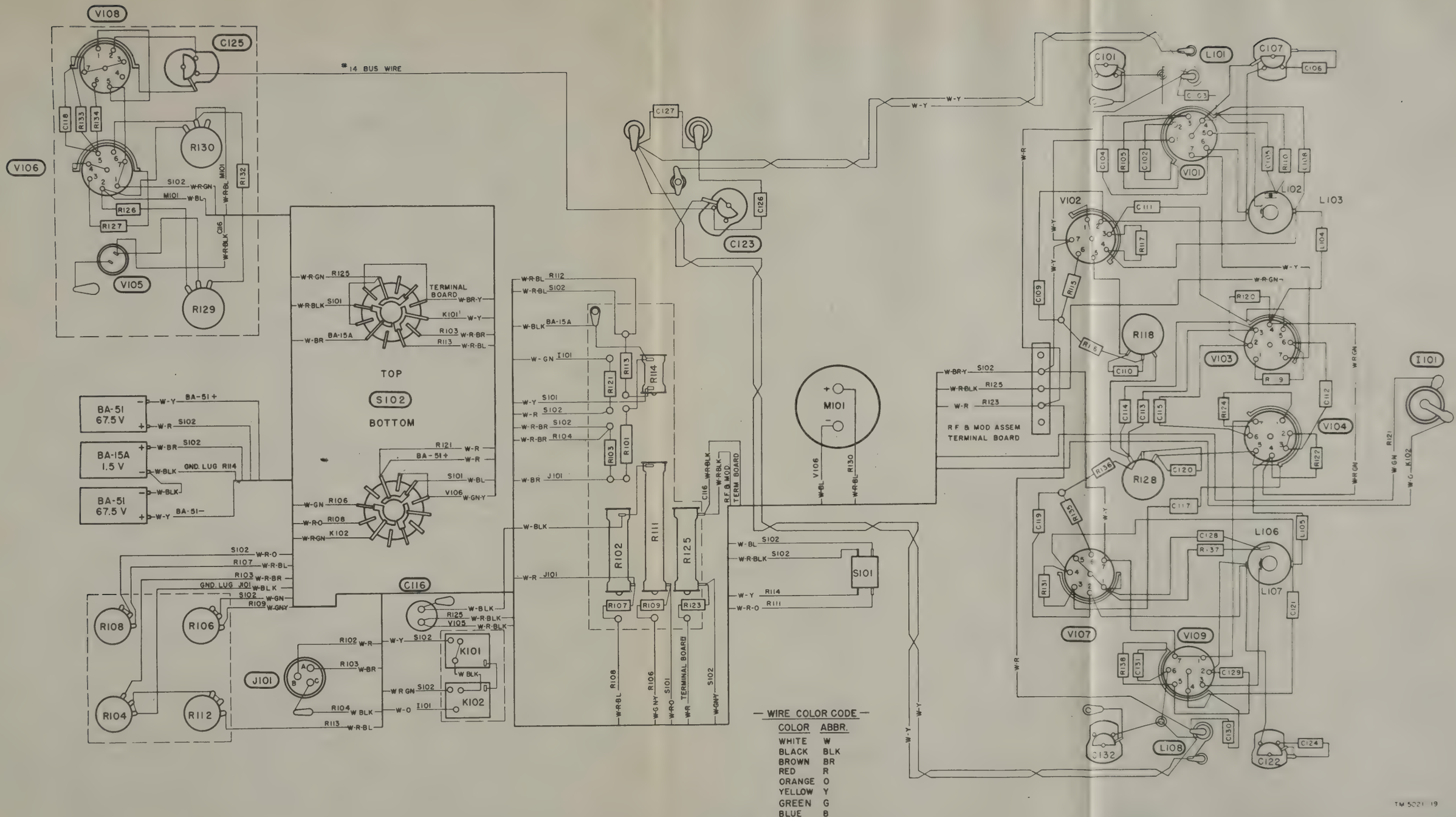
Figure 20. Radio Test Set TS-654/GRR-1, schematic diagram.

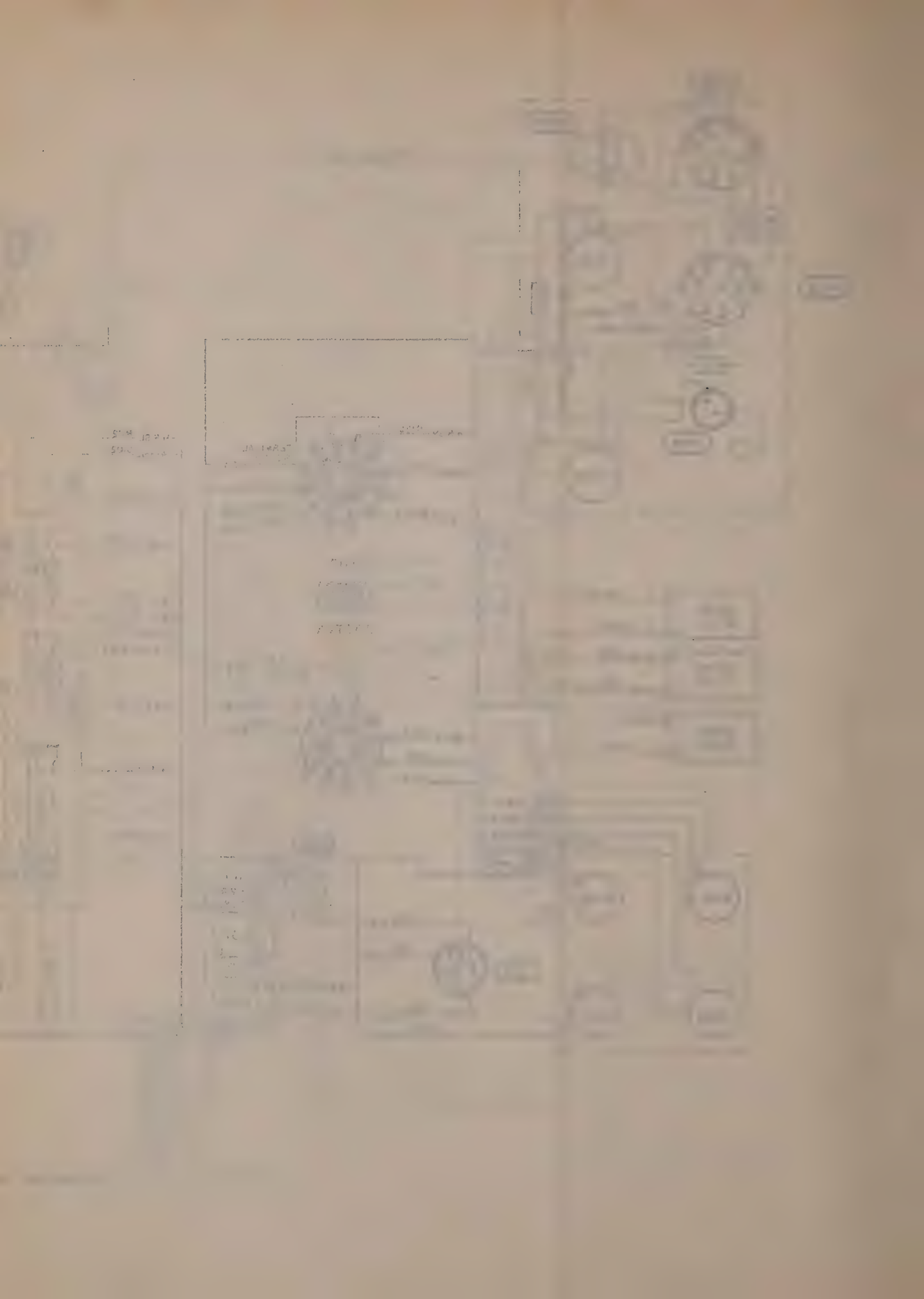



V108
V106
V105
V101
V103
V104
V109
C101
L101
C107
C106
C103
C118
R133
R134
R130
C104
R105
C102
C105
R110
C108
L102
L103
S102
W-R-GN
M101
W-BL
W-R-BL
R126
R127
C111
C116
W-R-BLK
R117
L104
W-Y
R129
R120
R118
C110
R119
I101
BA-51
67.5 V
BA-51+
W-Y
W-R
S102
C114
C113
C115
R124
C112
BA-15A
1.5 V
W-BR
W-BLK
GND. LUG
R136
R128
C120
R122
R121
K102
C117
C128
R137
L106
L105
L107
GND. LUG
R108
R106
C121
R104
R112
C132
L108
C130
C129
R138
C131
C124
C122

TM 5021-19




V108
C125
*14 BUS WIRE
V106
C118
R133
R134
R130
R132
S102
W-R-GN
M101
W-BL
W-R-BL
R126
R127
C116
W-R-BLK
V105
R129
C127
C126
C123
W-Y
L101
C101
C107
C106
C103
C104
R105
C102
V101
C108
R110
L108
L102
L103
V102
C111
R117
W-R
W-R-GN
R125
TERMINAL BOARD
W-BR-Y
S101
K101
R103
W-R-BR
R113
W-R-BL
BA-15A
W-BR
TOP
S102
BOTTOM
R121
BA-51+
R106
R108
K102
W-R-BL
R112
W-BLK
W-GN
I101
R121
R103
R101
W-R
S101
S102
R104
J101
R102
R111
R125
R107
R109
R123
C116
R125
V105
K101
K102
J101
R102
R103
R104
R112
W-BR
W-R-O
R107
GND. LUG J101
R109
W-GNY
C109
R115
R116
R118
C110
V103
R119
R120
W-BR-Y
W-R-BLK
R123
RF & MOD ASSEM TERMINAL BOARD
C114
C113
C115
R124
C112
V104
R122
R136
R128
C120
C117
C119
R135
R131
C128
R137
L106
L105
L107
C121
V107
V109
R138
C131
C129
C132
L108
C130
C124
C122
I101
R121
W-G
K102
M101
V106
R130
S101
R114
R111
C116
W-R-BLK
R.F. & MOD. TERM BOARD
W-R-BL
W-R-BLK
W-BL
W-R-BL
W-R-BLK
W-Y
W-R-O
W-G NY
W-R-O
W-R
W-GNY
S102
S101
TERMINAL BOARD
R108
R106
R101
R103
R102
R111
R125
R107
R109
R123
BA-51
67.5 V
BA-15A
1.5 V
BA-51
67.5 V
W-Y
BA-51+
W-R
S102
W-BR
S102
W-BLK
GND. LUG R114
W-BLK
BA-51-
W-Y
R108
R106
R104
R112
S102
W-R-O
R107
W-R-BL
R103
W-R-BR
GND. LUG J101
W-BLK
S102
W-GN
R109
W-GNY
J101
R102
R103
R104
R113
W-R
W-BR
W-BLK
W-R-BL
C116
R125
V105
W-BLK
W-R-BLK
W-Y
S102
K101
W BLK
W R GN
S102
K102
W-O
I101
W-R-BL
R108
W-G NY
R106
S101
W-R-O
TERMINAL BOARD
W-R
S102
W-GNY
S101
W-BL
S102
W-R-BLK
S102
W-Y
R114
W-R-O
R111
M101
V106
R130
W-BL
W-R-BL
W-R
W-Y
W-Y
W-Y
W-R
W-R-GN
W-R-GN
W-G
K102
W-Y
W-Y
W-Y
W-R
W-Y
W-Y
W-R
W-Y
W-Y
W-Y



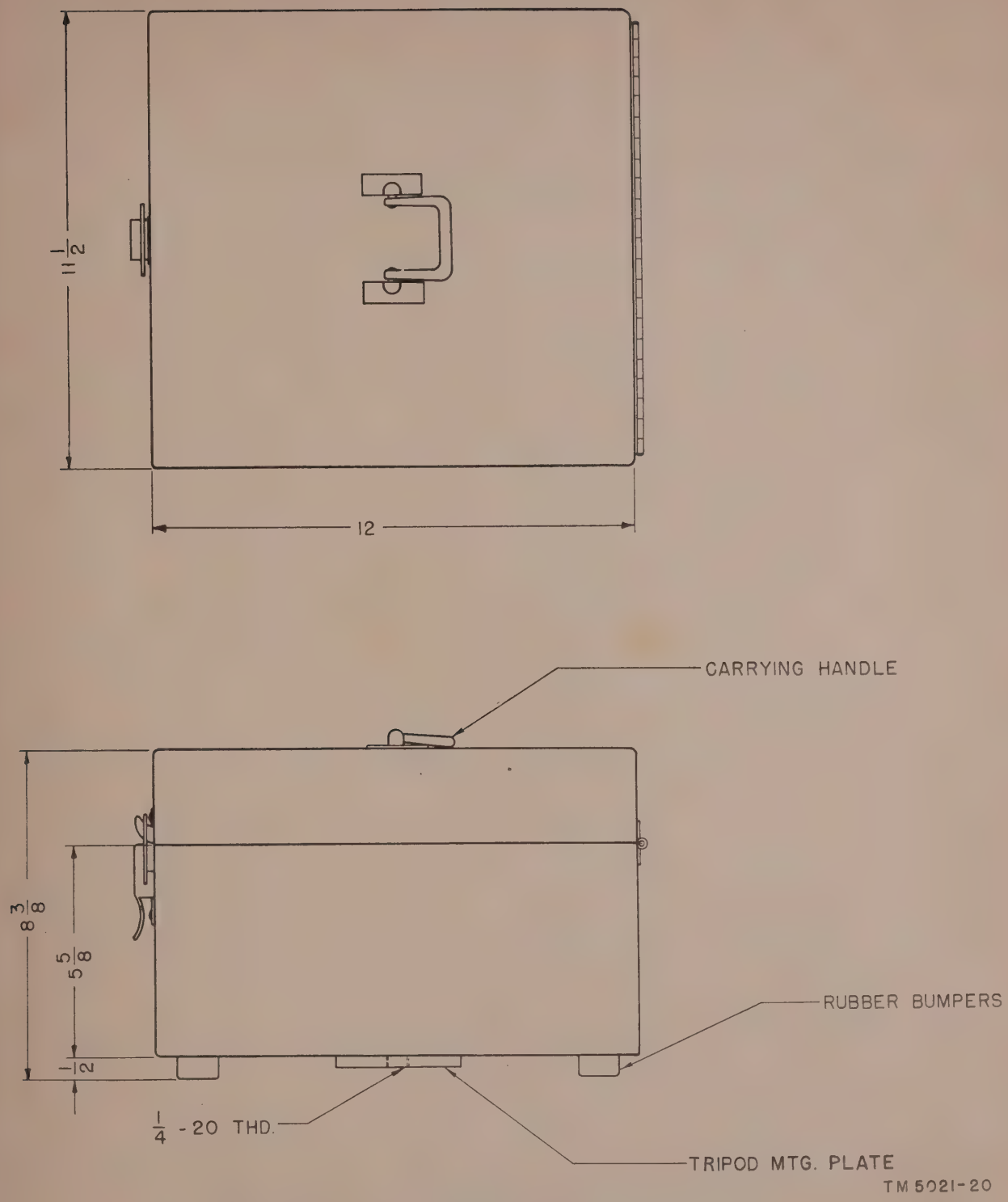


Figure 22. Radio Test Set TS-654/GRR-1, dimensional diagram.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

43. Repacking for Shipment or Limited Storage

The exact procedure in repacking for shipment or limited storage depends upon the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 9 and follow, in reverse order, the instructions given. Whenever practicable, place a dehydrating agent such as silica gel inside the case.

Section II. DEMOLITION TO PREVENT ENEMY USE

44. General

a. WHY. To prevent the enemy from using or salvaging this equipment.

b. WHEN. When ordered by your commander. Matériel will *not* be destroyed *except* upon order of proper authority.

c. HOW.

(1) *Smash.* Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

(2) *Cut.* Use axes, handaxes, machetes.

(3) *Burn.* Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

(4) *Explosives.* Use firearms, grenades, TNT.

(5) *Disposal.* Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

45. Method

a. USE ANYTHING IMMEDIATLY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

(1) *Smash.* Meter, controls, tubes, coils, switches, capacitors.

(2) *Cut.* Cords, wiring, nameplate.

(3) *Burn.* Cords, technical manuals, resistors, capacitors, coils, wiring.

(4) *Bend.* Panel, cabinet, chassis, loop.

(5) *Bury or scatter.* All the above pieces after destroying them.

b. DESTROY EVERYTHING.

APPENDIX I

REFERENCES

Note. For availability of items listed, check FM 21–6 and Department of the Army Supply Catalog SIG 1. Also see latest issue of FM 21–6 for applicable technical bulletins, supply bulletins, modification work orders, and changes.

---

1. Army Regulations

AR 380–5, Safeguarding Military Information.

2. Supply Publications

SIG 1, Introduction and Index.
SIG 3, List of Items for Troop Issue.
SIG 4–1, Allowances of Expendable Supplies.
SIG 4–2, Allowances of Expendable Supplies for Tactical Organizations, Training Centers, Boards, and Fixed Installations.
SIG 5, Stock List of All Items.
SIG 6, Sets of Equipment.
SIG 7 & 8, Organizational and Higher Echelon Spare Parts.
SIG 10, Fixed Plant Maintenance Lists.
SB 11–6, Dry Battery Supply Data.
SB 11–17, Electron Tube Supply and Reference Data.
SB 11–76, Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–300, Frequency Meter Sets SCR–211–(*).
TM 11–303, Test Sets I–56–C, –D, –H, and –J.
TM 11–307, Signal Generators I–72–G, H, J, and K.
TM 11–321, Test Set I–56–E.
TM 11–472, Repair and Calibration of Electrical Measuring Instruments.
TM 11–892, Radio Receiving Equipment AN/GRR–1.
TM 11–893, Handbook of Operating and Maintenance Instructions for AN/ART–4 (XA–3), AN/ART–4 (XA–4) Radio Transmitting Equipment.
TM 11–2613, Voltohmmeter I–166.
TM 11–2626, Test Unit I–176.
TM 11–2627, Tube Tester I–177.
TM 11–5022, Radio Test Set TS–655/GRR–1.

4. Painting, Preserving, and Lubrication

TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment.

5. Camouflage

FM 5–20, Camouflage, Basic Principles.

6. Decontamination

TM 3–220, Decontamination.

7. Demolition

FM 5–25, Explosives and Demolitions.

8. Packaging and Packing Instructions

a. Joint Army-Navy Packaging Specifications.

JAN–D–169, Desiccants, Activated.
JAN–P–100, General Specifications.
JAN–P–106, Boxes, Wood, Nailed.
JAN–P–116, Preservation, Methods of.
JAN–P–125, Barrier Material, Waterproof.
JAN–P–131, Barrier Material, Moisture-Vaporproof, Flexible.

b. U. S. Army Specification.

100–2E, Marking Shipments by Contractors (and Signal Corps Supplement thereto).

c. Signal Corps Instructions.

720–7, Standard Pack.
726–15, Interior Marking.

9. Other Publications

FM 24–18, Radio Communication.
TB SIG 66, Winter Maintenance of Signal Equipment.
TB SIG 72, Tropical Maintenance of Ground Signal Equipment.
TB SIG 75, Desert Maintenance of Ground Signal Equipment.
TB SIG 123, Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178, Preventive Maintenance Guide for Radio Communication Equipment.
TM 1–455, Electrical Fundamentals.
TM 11–314, Antennas and Antenna Systems.
TM 11–453, Shop Work.
TM 11–455, Radio Fundamentals.
TM 11–4000, Trouble Shooting and Repair of Radio Equipment.
TM 38–650, Basic Maintenance Manual.

10. Forms

WD AGO Form 468 (Unsatisfactory Equipment Report).
AF Form 54 (Unsatisfactory Report).

11. Abbreviations

cps	cycles per second.
dc	direct current.
f-m	frequency-modulated.
h-f	high-frequency.
K	1,000 ohms.
kc	kilocycle.
l-f	low-frequency.
mc	megacycle.
mopa	master oscillator power amplifier.
PM	preventive maintenance.
R–C	resistance-capacitance.
r-f	radio-frequency.
rms	root mean square.
VTVM	vacuum-tube voltmeter.

12. Glossary

Refer to the glossary in TM 11–455.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O & E, T/E, T/A, T/BA, SIG 6, SIG 7 & 8, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. Pamphlets of the Department of the Army Supply Catalog applicable to the equipment covered in this manual are listed in paragraph 1 below.

1. Supply Catalog Pamphlet

The following information was compiled on 25 October 1948. The appropriate pamphlet of the Department of the Army Supply Catalog is—

Organizational Maintenance Allowances and
Field and Base Maintenance Stockage Guide

SIG 7 & 8 AN/GRR–1

For an index of available catalog pamphlets, see the latest issue of Department of the Army Supply Catalog SIG 1.

2. Identification Table of Parts for Radio Test Set TS–654/GRR–1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
E101	ANTENNA, loop: for transmitting-receiving; copper tubing; silver plating, lacquered; 1 piece; 5″ mean diam, ⅜″ cross-section diam; 2 lugs ea having a 0.189″ diam hole, 13/16″ c to c; fixed; 55.5 to 56.75 mc.	Radiation and reception of 55.5- and 56.75-mc signals.	
W101	CABLE ASSEMBLY, special purpose: 3 cond; #20 AWG stranded wire; asbestos and fiberglas ins; skeleton fiberglas braid; ¼″ diam; 18½″ lg excluding term; AN3106–14S–IS connector on 1 end; 5-pin plug to fit BA–49 at other end.	Battery test cable	
C105, C128	CAPACITOR, fixed: mica; JAN type CM20D210J; 200 mmf ± 5%; 500 vdcw.	C105: Grid leak biasing, V101 C128: Grid leak biasing, V109	
C106, C124	CAPACITOR, fixed: mica; JAN type CM20D390J; 39 mmf ± 5%; 400 vdcw.	C106: Oscillator plate tuning, V101 C124: Oscillator plate tuning, V109	
C107, C125, C122	CAPACITOR, variable: air dielectric; plate meshing type; single sect; JAN type CT1CO25; 4.0 to 23.0 mmf; SLC characteristic; 600 v RMS flashover.	C107: Oscillator plate tuning, V101 125: Antenna tuning C122: Oscillator plate tuning, V109	
C109, C119	CAPACITOR, fixed: ceramic dielectric; JAN type CC21CL240J; 24 mmf ± 5%; temp coef 330 parts/million/° C; 500 vdcw.	C109: D-c blocking, V102 grid C119: D-c blocking, V107 grid	

2. Identification Table of Parts for Radio Test Set TS–654/GRR–1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C112 through C115	CAPACITOR, fixed: mica; JAN type CM35D103K; 10,000 mmf ± 10%; 300 vdcw; temp coef letter D.	C112: Coupling, V104 and V103 C113 and C114: Coupling, V103 to V102 and V107. C115: Coupling, V103 and V104	
C116	CAPACITOR, fixed: electrolytic; JAN type CE31F400M; single sect; 40 mf; 250 vdcw; operating temp range; −40° to 65° C.	B-plus filter	
C118, C126	CAPACITOR, fixed: mica; JAN type CM20D510J; 51 mmf ± 5%; 500 vdcw.	C118: Filter, V108 output C126: D-c blocking, loop antenna	
C123	CAPACITOR, variable: air dielectric; plate meshing type; single sect; JAN type CT1E010; 3.5 to 9 mmf SLC characteristic; 600 v RMS flashover.	Antenna TUNE control	
C103, C108, C111, C117, C121, C130.	CAPACITOR, fixed: mica; JAN type CM25D102K; 1,000 mmf ± 10%; 500 vdcw.	C103: R-f ground return, L101A C108: B-plus decoupling C111: Screen bypass, V102 C117: Screen bypass, V107 C121: B-plus decoupling C130: R-f ground return, L108A	
C101, C132	CAPACITOR, variable: air dielectric; plate meshing type; single sect; JAN type CT1E010; 3.5 to 9 mmf; SLC characteristic; 600 v RMS flashover.	C101: 56.75 MC CHANNEL ADJ C132: 55.5 MC CHANNEL ADJ	
C102, C110, C127, C120, C131	CAPACITOR, fixed: ceramic dielectric; JAN type CC21CH100G; 10 mmf ± 2%; 500 vdcw.	C102: PA plate tuning, V101 C110: R-f decoupling, V102 C127: Antenna tuning C120: R-f decoupling, V107 C131: PA plate tuning, V109	
C104, C129	CAPACITOR, fixed: ceramic dielectric; JAN type CC21SL510K; 51 mmf ± 10%; 500 vdcw.	C104: D-c blocking, V101 grid C129: D-c blocking, V109 grid	
L101, L108	COIL, RF: plate tuning; 2 windings, single layer wound; unshielded; pri, 5½ turns of #16 E wire; secd, turn link 1¼″ lg x ½″ diam; solid phenolic form; mtg hole in bottom tapped for #6–32 screw; 1 solder lug term, 1 wire lead term.	L101: V101 plate coil and output coupling link. L108: V109 plate coil and output coupling link.	
L102, L106	COIL, RF: oscillator plate; single winding, layer wound; unshielded; 7½ turns #20 E wire; phenolic form; air core base 1¼″ diam winding area ⅜″ diam x ¾″ h overall; 3 mtg holes 0.147″ diam spaced 120 deg apart; 2 solder lug term.	L102: Oscillator plate coil, V101 L106: Oscillator plate coil, V109	
L103, L107	COIL, RF: oscillator grid; single winding, layer wound; unshielded; 4⅔ turns of #24 E wire; phenolic form; air core base 1¼″ diam; winding area 0.500″ diam; ¾″ lg overall; 3 mtg holes 0.147″ diam spaced 120 deg apart; 2 solder lug term.	L103: Oscillator grid coil, V101 L107: Oscillator grid coil, V109	
L104, L105	COIL, RF: choke; single winding; universal wound; unshielded; 25 microhenrys; ⅜″ diam x ¾″ lg; phenolic form; 2 axial wire term; 70 turns #40 DCE; 3.5 ohms resistance.	R-f decoupling	

2. Identification Table of Parts for Radio Test Set TS–654/GRR–1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
P101	CONNECTOR, female receptacle: 3 round cont; pol straight type; $1\frac{11}{32}$″ x $1\frac{1}{16}$″ diam cylindrical cast body; molded phenolic insert.	Battery test cable termination	
J101	CONNECTOR, male receptacle: 3 round cont; pol straight type; $1\frac{3}{16}$″ h x $1\frac{3}{16}$″ lg; cylindrical cast body; molded phenolic insert; mts in a ⅞″ diam hole; four 0.120″ mtg holes.	EXTERNAL BATT test receptacle	
H101	HOLDER, battery: for holding batteries BA–15–A and BA–51 in Radio Test Set TS–654/GRR–1; c/o a plate and a channel shaped clamp; aluminum, caustic dipped; $7\frac{1}{2}$″ x $10\frac{1}{8}$″ x $2\frac{1}{4}$″ overall; mts w/4 camlocs located $6\frac{1}{2}$″ x 7″ on ctrs.	Battery holder	
V105	LAMP, glow: ¼w ;10 5–125; bulb T–4–1/2; DC; GE #NE16.	Voltage regulator	
I101A	LAMP, glow; $\frac{1}{25}$ w, 105–125 v; T–3–1/4 bulb, clear; length $1\frac{3}{16}$″ overall; miniature bayonet base; GE #NE51.	BATTERY TEST lamp	
I101	LIGHT, indicator: w/lens; ½″ diam clear faceted lens; for minature bayonet base; T–3–¼ bulb; $\frac{1}{25}$ w; $1\frac{15}{16}$″ wd x $\frac{15}{16}$″ h; $\frac{11}{16}$″ mtg hole; horizontally mtd; lamp replaceable from front of panel; thd jewel; 2 solder lugs at base of socket.	Lamp holder	
M101	METER, DC: range 0–150 ua; round metal flush mtg case; 2.695″ OD; barrel 1.60″ lg x 2.21″ diam; 1.563″ overall behind flange; D'Arsonval movement; calibrated for use on nonmagnetic panel; black numerals on white background; 3 mtg holes ⅛″ diam on radius of 1.22″ spaced 120 deg apart; 2 stud term; Marion Elec Instr type #HM2–2½.	Output and input level indicator	
K101, K102	RELAY, armature: cont arrangement SPDT; cont rating 3 amp; $\frac{3}{32}$″ diam silver cont; dual-wound coil connected in parallel; 500 ohms; 5 solder lug term on coil and cont.	Battery testing	
R134	RESISTOR, fixed: composition; JAN type RC20AE205J; 2 meg ±5%; ½ w.	Load resistor, V108	
R101	RESISTOR, fixed: WW; JAN type RU4B7R5J; 7.5 ohms ±5%; 1 w.	External battery load	
R102, R125	RESISTOR, fixed; WW; JAN type RW32C402; 4000 ohms ±10%; 5 w.	R102: External battery load R125: B-plus dropping	
R105, R110, R117, R131, R137, R138	RESISTOR, fixed: composition; JAN type RC20AE303J; 30,000 ohms ±5%; ½w.	R105: PA grid return, V101 R110: Oscillator grid leak, V101 R117: Screen dropping, V102 R131: Screen dropping, V107 R137: Oscillator grid leak, V109 R138: PA grid return, V109	
R103	RESISTOR, fixed: composition; JAN type RC20AE510J; 51 ohms ±5%; ½ w.	External battery current limiting	

2. Identification Table of Parts for Radio Test Set TS–654/GRR–1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R104, R108, R112	RESISTOR, variable: (potentiometer); composition; 1000 ohms ±10%; 2.25 w; 3 solder lug term.	R104 and R108: External battery test threshold adjustment. R112: Internal battery test threshold adjustment.	
R107, R109	RESISTOR, fixed: composition; JAN type RC20AE363J; 36,000 ohms ±5%; ½ w.	R107: External battery current limiter R109: Internal battery current limiter	
R106	RESISTOR, variable: (potentiometer); composition; 10,000 ohms ±10%; 2.25 w; solder lug term.	Internal battery threshold adjustment	
R111	RESISTOR, fixed: WW; JAN type RW33C632; 6300 ohms ±5%; 8 w.	Internal battery load	
R113	RESISTOR, fixed: composition; JAN type RC20AE560J; 56 ohms ±5%; ½ w.	Internal battery current limiter	
R114	RESISTOR, fixed: WW; JAN type RW-30GIR6; 1.6 ohms ±5%; 7 w.	Internal battery load	
R115, R135	RESISTOR, fixed: composition; JAN type RC20AE512J; 5100 ohms ±5%; ½ w.	R115: Phase splitting, V102 grid R135: Phase splitting, V107 grid	
R116, R126, R136	RESISTOR, fixed: composition; JAN type RC20AE103K; 10,000 ohms ±10%; ½ w.	R116: R-f decoupling, V102 R126: Plate load, V106 R136: R-f decoupling, V107	
R119, R124	RESISTOR, fixed: composition; JAN type RC20AE305J; 3 meg ±5%; ½ w.	R119: Grid return, V103 R124: Grid return, V104	
R120, R121, R122	RESISTOR, fixed: composition; JAN type RC20AE683J; 68,000 ohms ±5%; ½ w.	R120: Plate load, V103 R121: Voltage dropping, I101A R122: Plate load, V104	
R118, R128	RESISTOR, variable: (potentiometer); composition; 100,000 ohms ±10%; 2.25 w; 3 solder lug term.	Multivibrator output controls	
R123	RESISTOR, fixed: composition; JAN type RC20AE203J; 20,000 ohms ±5%; ½ w.	PA plate voltage-dropping	
R127, R133	RESISTOR, fixed: composition; JAN type RC20AE105K; 1 meg ±10%; ½ w.	Grid return, V106	
R129, R130	RESISTOR, variable: (potentiometer; com-) position; 5000 ohms ±10%; 2.25 w; 3 solder lug term.	R129: M101 zero adjusting R130: M101 sensitivity control	
R132	RESISTOR, fixed: composition; JAN type RC20AE123K; 12,000 ohms ±10%; ½ w.	Plate load, V106	
X101 through X104, X106 through X109	SOCKET, tube: 7 cont miniature; JAN SO–11C.	X101 through X104: Tube sockets for V101 through V104. X106 through X109: Tube sockets for V106 through V109.	
S102	SWITCH, rotary: 6 pole, 3 position, 2 sect; silver pl brass cont; phenolic body 1⅞″ diam x 2⅛″ d; 24-cont term; single hole mtg.	RECEIVER—EXTERNAL BATT TEST TARGET switch.	
S101	SWITCH, push: DPST; 6 amp; phenolic body 1¾″ lg x ¾″ wd x ⅝″ h; momentary action; normally open; solder lug term; single hole mtg.	INTERNAL BATT TEST switch	
A101	TRIPOD: still-camera type; 59½″ extended, 35″ collapsed; wooden legs, cast aluminum head; Flote plate head.	Test set support	
V101, V106, V109	TUBE, electron: JAN–3A5; dual triode	V101: High-channel mopa V106: VTVM amplifier V109: Low-channel mopa	

2. Identification Table of Parts for Radio Test Set TS–654/GRR–1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
V102, V103, V104, V107.	TUBE, electron: JAN–1L4; pentode	V102: High-channel reactance modulator.	
		V103 and V104: Multivibrator	
		V107: Low-channel reactance modulator.	
V108	TUBE, electron: JAN–1A3; diode	VTVM diode detector	

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